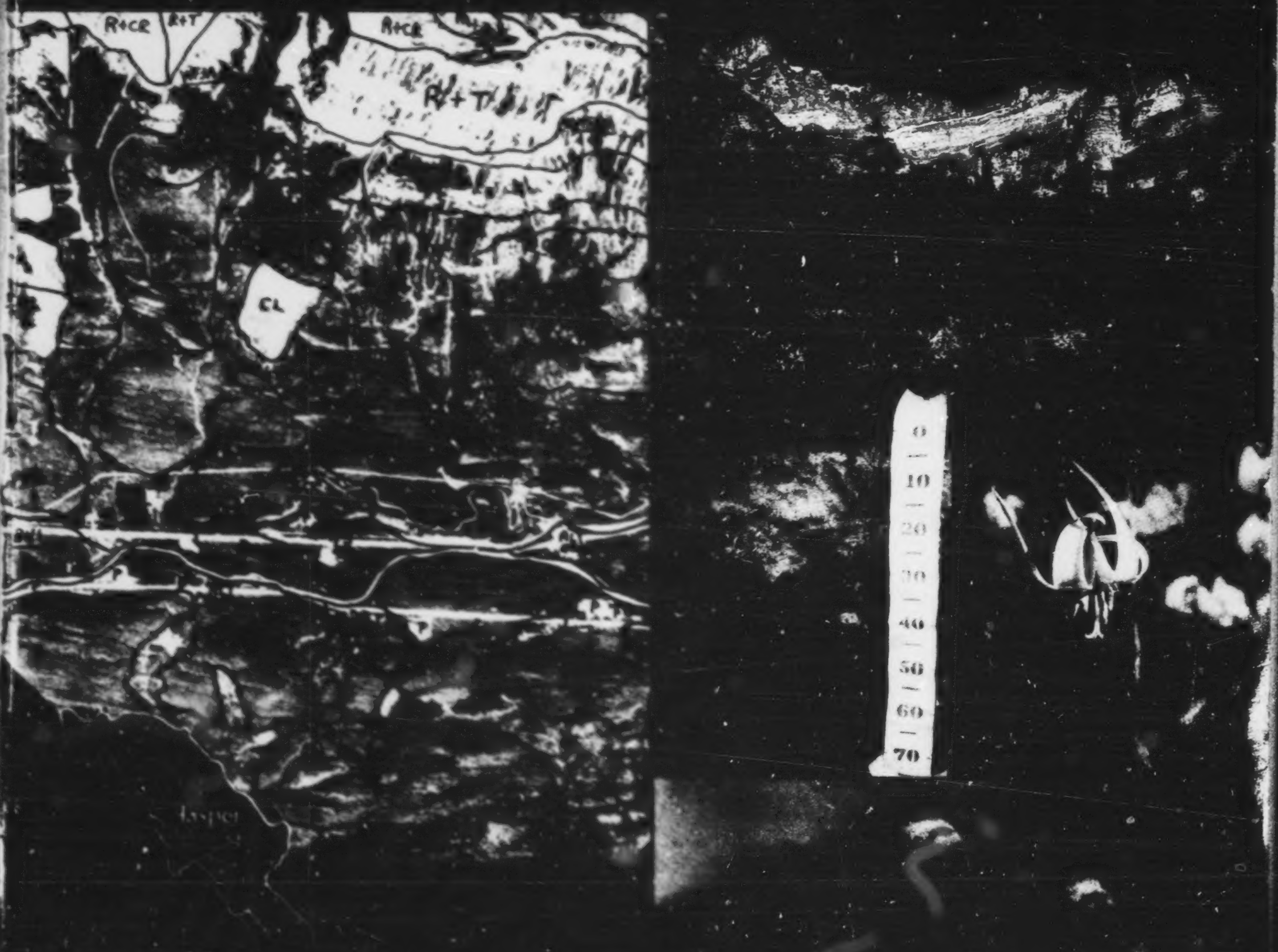
Ecological (Biophysical) Land Classification Of Banff and Jasper National Parks

Volume I: Summary

General Editors: W. D. Holland and G. M. Coen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ABSTRACT

Banff and Jasper National Parks occupy about 17,520 km² (6765 mi²) in Canada's southern Rocky Mountains. The area extends from approximately 53° 30′ N and 119° 30′ W at the northwest corner of Jasper to about 50° 40′ N and 115° 20′ W at the southern extremity of Banff. It is bounded on the west by the Continental Divide. The Ecological (Biophysical) Land Classification of Banff and Jasper presents landform and soil, vegetation and wildlife information in a map and descriptive format at a scale of 1:50,000 using a legend that integrates the resource components in a holistic fashion. A three-level, hierarchical land classification system was developed using established landform and soil taxonomies, plus a classification of 85 vegetation types developed by the authors. The three levels are based on existing guidelines for Ecological (Biophysical) Land Classification in Canada and include, from highest to lowest level of generalization, Ecoregion, Ecosection, and Ecosite.

Ecoregion separations are based primarily on vegetation physiognomy and species composition which reflect macroclimate. Montane, Subalpine, and Alpine Ecoregions are recognized. The Subalpine Ecoregion is subdivided into Lower Subalpine and Upper Subalpine portions based on vegetational characteristics reflecting macroclimatic differences.

The Ecoregions are divided into 55 Ecosections. Ecosection separations are based on broad landform, drainage class, and soil differences. Landforms are comprised of ten genetic materials that have been divided into twenty genetic material units based on broad textural and chemical (calcareousness/reaction) differences.

The Ecosections are further separated into 124 Ecosites based on specific soil and vegetational differences that are considered insufficient, in magnitude or kind, to warrant separation at the Ecosection level. The Ecosites, plus eight Miscellaneous Landscapes, are the mapping units delineated on 1:50,000 maps. Wildlife information is presented at the Ecosite level. The importance of each Ecosite for most of the large and medium size mammals is described. Eighteen breeding bird associations and seven small mammal associations are defined using multivariate statistics. The association and its relative abundance are listed for each Ecosite. The landform, soil, vegetation, and wildlife of each Ecosite are briefly described in this volume.

PREFACE

Parks Canada requested assistance to meet a number of objectives of the National Parks Inventory Program. The request indicated a need for knowledge of the kinds and distribution of landforms, soils, vegetation, and wildlife. Such baseline information, plus the elucidation of some basic ecological relationships among these natural resource components, is primarily for resource management and land use planning within the National Parks.

Parks Canada initiated an Ecological (Biophysical) Land classification of Banff and Jasper National Parks (Fig. 1) in May 1974 as part of their resource inventory program. The objective was to provide an integrated landform, soil, vegetation, and wildlife inventory of the two parks at a scale of 1:50,000 with data presented in map and report format. The field work was completed in 1980.

The Ecological (Biophysical) Land Classification of Banff and Jasper studied the geomorphology, soils, vegetation, and wildlife of these two parks, exclusive of cultural features and land use patterns present as a result of development since 1885. Though aware of cultural features, land use patterns, and land use conflicts within the two parks, the inventory team followed the terms of reference established by Day et al. (1975). The concept of natural resource studies and their advantages and deficiencies were also described by McTaggart-Cowan (1977). However, most of the land in the parks is not intensively used. Byrne (1968), Scace (1968, 1970), and Nelson (1970) present much of the history and development that has affected Banff National Park. Further sources of information are contained in the three volume bibliography by Scace (1973).

The complete Banff-Jasper report consists of three volumes plus a map supplement and contains generalized and detailed descriptions of the landform, soil, vegetation, and wildlife resources.

Volume I is a summary account of landforms, soils, vegetation, and wildlife.

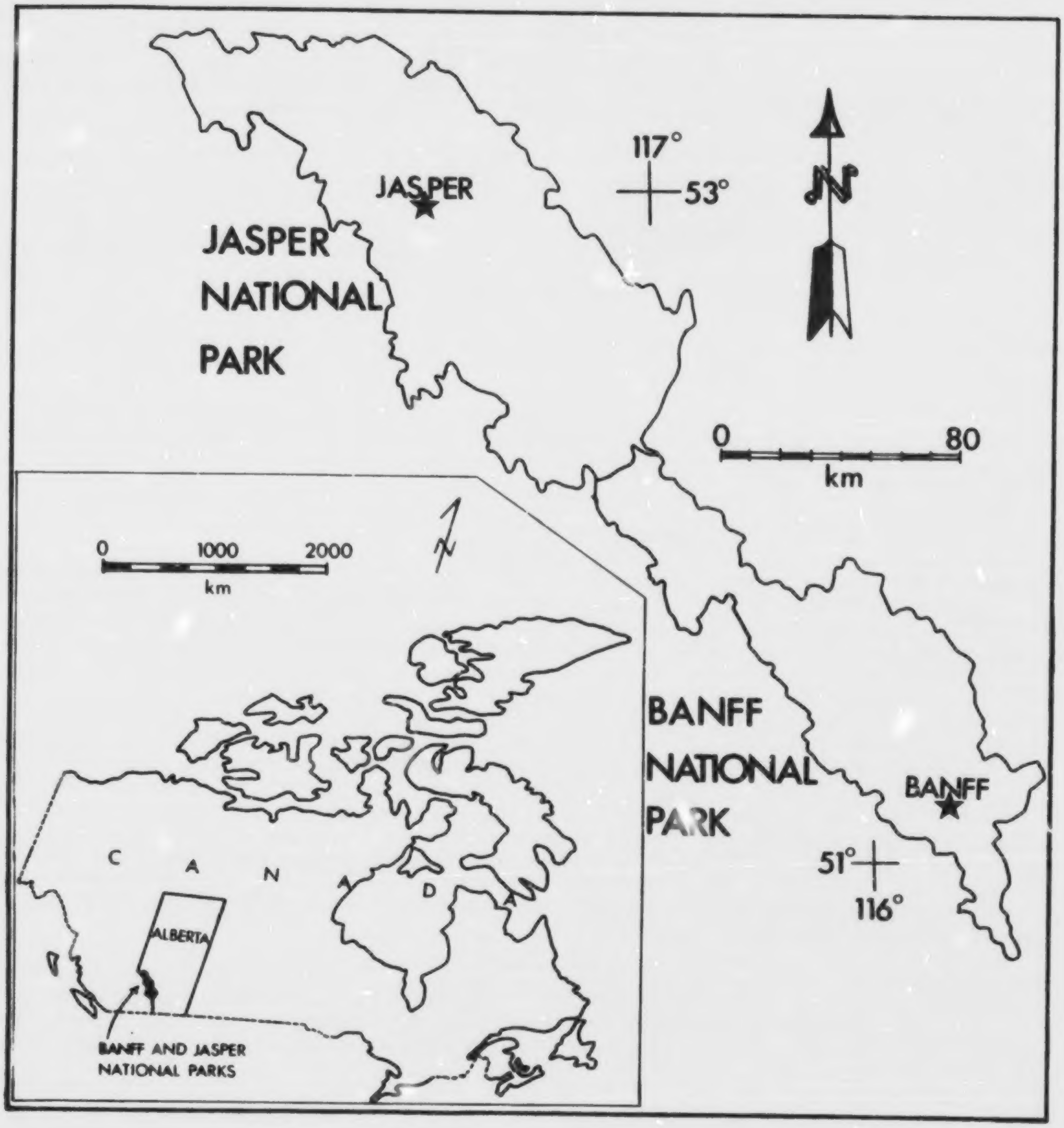
Chapter I of this volume contains the methodologies used both in the collection and processing of basic data andin the development of an integrated, holistic ecological land classfication system. Chapter II describes the study area in general. Chapter III provides Ecosection/Ecosite descriptions summarized from Volumes II and III and includes comments on management considerations. Chapter IV concerns resource use interpretation. It provides information on interpretive classification to help resource managers make land use suitability decisions.

Volume II contains a detailed account of the landforms, soils and vegetation. It describes the physical environment, including climate, physiography, topography, geology and geomorphology. The soil orders encountered and their distribution are also outlined. The vegetation information describes 85 vegetation types (v.t.s), a key to v.t. identification, an overview of community succession, special and significant species, and a checklist of vascular and nonvascular plants. The main body of Volume II provides an ecological integration of landforms, soils, and vegetation into three Ecoregions, 55 Ecosections and 124 Ecosites. An encyclopedic style was adopted to allow readers to consult the report on the subject of immediate interest without necessarily reading it from the beginning.

Volume III reports on the wildlife portion of the inventory. It contains a detailed discussion of the occurrence and abundance of each species of herptile, bird and mammal. Included are habitat preferences and notes on life history and management considerations specific to each species. The discussion of wildlife occurence on each Ecosite in Volume I is summarized from Volume III.

Other sections in Volume III describe breeding bird communities, small mammal associations, bird migration, ungulate range surveys, wildlife distribution by watershed, and various recommendations.

Fig. 1. Location of study area


JASPER
JASPER NATIONAL PARK
117°
53°
N
0
80
km
BANFF NATIONAL PARK
BANFF
51°
116°
0
1000
2000
km
C A N A D A
ALBERTA
BANFF AND JASPER NATIONAL PARKS

The fourth part of the report is a map supplement, containing 24 maps (scale 1:50,000) and the Master Legend. The maps depict the distribution of Ecosites and Miscellaneous Landscapes. The Master Legend contains abbreviated information on the landform, soils, vegetation and wildlife of each Ecosite.

To obtain the most complete information, all report components should be used together. In addition, users should be aware that the information in this report is scale dependent. Site specific management decisions require site inspection and ground-truthing of the Ecosite data. Users may find it useful to consult with the authors regarding valid use of the information.

Copies of the original annotated air photos are filed with the Resources Studies Manager, Western Regional Office, Parks Canada, Calgary. Most basic data are stored in the Canada Soil Information System (CanSIS), Land Resource Research Institute, Ottawa.

CHAPTER I - METHODS

ECOLOGICAL (BIOPHYSICAL) LAND CLASSIFICATION METHODS……………………
W.S. Taylor, B.D. Walker and G.M. Coen.
METHODS OF SOIL DESCRIPTION AND ANALYSIS……………………B.D. Walker
METHODS OF VEGETATION DESCRIPTION AND ANALYSIS……………………P.L. Achuff
METHODS OF WILDLIFE DESCRIPTION AND ANALYSIS……………………G.L. Holroyd
and K.J. Van Tighem

ECOLOGICAL (BIOPHYSICAL) LAND CLASSIFICATION METHODS

PHILOSOPHICAL PRINCIPLES GOVERNING DEVELOPMENT OF THE ECOLOGICAL CLASSIFICATION METHODOLOGY

Experience has shown that for ease of use, all resource sectors should be linked to one set of map polygons of appropriate scale (1:50,000 was chosen for Banff-Jasper, Day et al. 1975) and the map legend should describe holistic, repeating ecological map unit concepts.

Three guidelines were used to develop the mapping procedure for Banff and Jasper:

1. Map, legend, and report should be easily interpretable.
2. Map unit concepts should be repetitive and holistic.
3. Map information should be uniform in reliability and intensity.

These guidelines were addressed by choosing a semi-closed legend and simple map symbol encompassing a holistic, ecological concept of landform, soils, and vegetation. Only the slope and, occasionally, selected landscape modifying processes were allowed to vary somewhat independently of the concept as applied to map polygons. This choice allowed the development of an ecological map unit concept (Jurdant et al. 1975, Rowe 1979), limited the number of concepts, permitted legend interpretation followed by mechanical labeling of repetitive map polygons, and included many factors in an easily remembered symbol. It also allows transfer of experience from a familiar area to an unfamiliar, but similarly labeled, area without reference to the many specific landscape components such as texture or lime.

Map delineations were chosen to correspond with recognizable landscape (usually landform) features because soil and vegetation often change where landforms change and reliable extrapolation from aerial photographs is possible. The smallest practical map polygon at scale 1:50,000 is 0.5 to 1 cm^2 and represents a tract of 25 to 40 ha (50 to 100 acres).

The legend in this study is hierarchical, but the mapping is not. That is, while initial landscape stratification established Ecoregion, Ecoregion subunit, and genetic material unit boundaries (Plates 82, 83, 84, Vol. II), in the final mapping polygons were named at the Ecosite level and modified by slope class. Thus, land is not cartographically stratified into polygons representing the Ecosection or Ecoregion however, therefore the aggregate that is Ecosection exists conceptually and therefore the legend is hierarchical.

MAPPING METHODOLOGY

METHODOLOGY OF LEGEND DEVELOPMENT

No nationally acceptable taxonomic system for ecological classification exists. There are useful guidelines (Lacate 1969, Jurdant et al. 1975, Wiken 1980) for developing classification procedures. A vegetation "community type" taxonomy was developed for Banff and Jasper and combined with existing landform and soil taxonomies into a legend that defines the mapping units. This was accomplished through a series of annual legend, vegetation taxonomy, and mapping refinements following field checking of pretyped areas. Field teams consisted of one soil and one vegetation scientist, each recording information at a mutally acceptable, representative point on the landscape. Wildlife data collected the following season were also incorporated into this iterative process and resulted in further refinement of the Ecosite concept.

DESIGN OF THE MAPPING LEGEND

The mapping legend was developed with limits separating mapping concepts coincident with probable taxon limits where possible. The following discussion of Ecoregions, Ecosections, and Ecosites shows how these taxonomic levels influenced the mapping legend.

ECOREGIONS

Three Ecoregions are represented in Banff and Jasper: Montane, Subalpine, and Alpine. Separation was based on differences in vegetation physiognomy and species composition that reflect differences in macroclimate.

ECOSECTIONS

Ecoregions were divided into 55 Ecosections, based on broad genetic material and drainage class differences. These were named after geographic features and assigned a two letter, connotative symbol.

Genetic material classes that resulted in the establishment of Ecosections are listed in Table 1. These eight groupings were subdivided into two moisture regimes: *wet terrain* with soils classed as poorly drained and very poorly drained (C.S.S.C. 1978b) and *non-wet terrain* with soils classed as moderately well drained and drier. Imperfectly drained areas were variously considered wet or non-wet depending on their spatial and conceptual associates.

Wet terrain was not further subdivided. Non-wet terrain was subdivided on one or more of the following criteria where appropriate in occurrence, extent, or homogeneity:

1. Calcareous versus noncalcareous genetic materials.
2. Three genetic material textural groups, specifically coarse with >60% sand (sand, loamy sand, part of sandy loam), medium (loam, silt loam, part of sandy loam) and fine (clay loam, silty clay loam, silty clay textural classes). Textural classes are as defined by C.S.S.C. (1978a).
3. Soil-vegetation classes reflecting geomorphic activity or mesoclimate within a Genetic Material Unit (Table 8).
4. Landform surface expression producing a cartographically inseparable dry>wet landscape pattern.

Table 2 shows, as an example, organization of Lower Subalpine Ecosections associated with glacial genetic materials.

ECOSITES

The 55 Ecosections were further separated into 124 Ecosites on the basis of vegetation physiognomic and floristic differences as well as differences in soil parameters. They were named as numerical subdivisions of the Ecosection name. Subdivision into Ecosites was based on the following criteria where appropriate in occurrence, extent, or homogeneity:

1. Vegetation physiognomic groupings (closed forest, open forest, shrub, low shrub and herb, herb).
2. Habitat grouping (poplar forest, lodgepole pine forest, lodgepole pine/buffaloberry forest, Engelmann spruce-subalpine fir forest, a mosaic near timberline of heath tundra plus scattered Engelmann spruce-subalpine fir trees or krummholz, subalpine larch forest, avalanche complex vegetation).
3. Genetically similar soil or landform parameters (imperfectly drained soils, moderately

Table 1. Organization of Ecosections by Ecoregion and genetic material classes.

Genetic Material	Ecoregions and Subdivisions			
	Montane	Subalpine		Alpine
		Lower	Upper	
Residual	-	BZ	CP	HE
Landslide	GA	IB	BP	-
Colluvial	-	FV, SB	EN, WH, WF	BS, RD, TK
Glacial (morainal plus ice contact stratified)	PT, NY	BK, BY, CA, CV*, GT, ML, PR, (TZ)‡, WW †	AZ, EG, LV, PL, SF, SX*, TR	EF, JN, MP
Glaciofluvial	AT	BV, (TZ)	NG	-
Fluvial (including fluviolacustrine)	FR, HD, VL*	AL, HC*, PP, VD	CN, MQ, NT*	KA
Glaciolacustrine	NH*, RK	MC*, SP	-	-
Eolian	DV, TA	-	-	-

* Dominantly wet terrain

† Refer to Table 2

‡ The TZ Ecosection is defined as being associated with two genetic material classes

well drained and drier soils, or Brunisolic soils, Brunisolic-Regosolic soils, and Brunisolic-Podzolic soils, or ice contact stratified material and morainal material).

4. Complex Map Units (cartographically inseparable soil and vegetation patterns controlled by northerly and southerly aspect, dry and wet terrain, varying soil parent material depths over bedrock).

Table 3 gives an example of the subdivision of an Ecosection into its component Ecosites.

METHODS OF SOIL DESCRIPTION AND ANALYSIS

Pedon and site information as suggested by Day et al. (1975) was recorded on computer coding forms using the procedures and guidelines of Dumanski et al. (1975) and C.S.S.C. (1978 a,b). The soil, site, and vegetation data were sorted and organized by computer as an aid to developing and refining the mapping legend.

FIELD EXAMINATION AND SOIL DESCRIPTION METHODS

Ground checking was carried out after initial landscape stratification on aerial photographs to refine polygon boundary locations and to corroborate interpretation of landform, soil, and vegetation. Observation sites were located and annotated on the aerial photographs. Various pedons were chosen to represent soils of each Ecosite after ground checking and mapping procedures were completed. These pedons were described in detail on CanSIS forms and sampled for routine laboratory analysis.

Table 2. Example of Ecosection separations with glacial genetic materials (refer to Table 13) in the Lower Subalpine Ecoregion.

Glacial Genetic Materials of the Lower Subalpine								
Dominantly Wet Terrain	**Dominantly Non-wet Terrain**							
	Noncalcareous			**Calcareous**				
	Medium Texture	**Coarse Texture**		**Dominantly Medium Texture**				
		Morainal	Ice contact stratified	Regosolic herb	Brunisolic-Regosolic pine or grassland-pine	Brunisolic-Luvisolic pine	Brunisolic-Podzolic spruce-fir	Dry>wet pattern
CV	CA	ML	(TZ)*	WW	GT	PR+	BY	BK

* Subdominant genetic material is noncalcareous, coarse textured glaciofluvial

+ Refer to Table 3

Table 3. Example of Ecosite separations within an Ecosection.

Ecosite	Landform*	Soils	Vegetation†
PR1	Till C blankets overlying inclined bedrock	Eutric Brunisols > Gray Luvisols	lodgepole pine false azalea, lodgepole pine feathermoss, lodgepole pine Labrador tea
PR2	Till C blankets overlying inclined bedrock	Eutric Brunisols > Gray Luvisols	logepole pine buffaloberry
PR3	Till C blankets overlying inclined or hummocky bedrock, hummocky Till C	gleyed Eutric Brunisols > gleyed Gray Luvisols	lodgepole pine forest
PR4	inclined Till C and Ice Contact Stratified Drift B	Northerly aspects: Eutric Brunisols Southerly aspects: Eutric Brunisols > Gray Luvisols, Regosols	Northerly aspects: Engelmann spruce - subalpine fir forest Southerly aspects: logepole pine forest
PR6	Ice Contact Stratified Drift B blankets overlying inclined or hummocky bedrock, hummocky Ice Contact Stratified Drift B	Eutric Brunisols > Gray Luvisols	lodgepole pine forest

* **Landform** Specific genetic material units are presented, refer to Geomorphology section, and Table 6

† **Vegetation** In order to differentiate PR1 from PR2, vegetation is presented at a more detailed level of description than for the other PR Ecosites.

CHEMICAL AND PHYSICAL ANALYTICAL METHODS

LABORATORY ANALYSIS

Chemical and physical analyses were carried out after the samples were air dried and ground according to the routine procedures used by the Alberta Institute of Pedology (C.S.S.C. 1978c). These involved a determination of:

Soil Reaction: pH was determined with a pH meter using a 2:1 0.01 M $CaCl_2$ solution to soil ratio (Peech 1965).[3.1 1][1]

Total Nitrogen: determined by the macro Kjeldahl-Wilforth-Gunning method (A.O.A.C. 1955). A mixture of HgO, $CuSO_4$, and K_2SO_4 (Kelpak) was used as a catalyst.

Calcium Carbonate Equivalent: inorganic carbon manometric method of Bascombe (1961).

Organic Carbon: by difference between total carbon and inorganic carbon. Total carbon was determined by dry combustion using an induction furnace (Allison et al. 1965) with a gasimetric detection of evolved CO_2 (Leco model 577-100). [3.61 1]

Cation Exchange Capacity: by displacement of ammonium with sodium chloride (Chapman 1965) except that an ammonium ion electrode was used to detect the displaced ammonium ion. [3.32 1]

Exchangeable Cations: extraction by Neutral N NH_4OAC (A.O.A.C 1955) with K, Mg, Na, and Ca determined by atomic absorption spectroscopy. [3.53, 3.531]

Sodium Pyrophosphate Extractable Iron and Aluminum: by McKeague (1967) method. The determination of Fe and Al was done by atomic absorption spectroscopy. [3.53,3.531]

Particle Size Distribution: by the pipette method of Kilmer and Alexander (1949) as modified by Toogood and Peters (1953), except that carbonates were not removed prior to dispersion.

Liquid Limit, Plastic Limit, and Plasticity Index: by the method outlined by ASTM (1970). [2.61, 2.62, 2.63]

One-third and Fifteen Bar Moisture: by the pressure plate and pressure membrane methods (U.S. Salinity Laboratory Staff 1954). [2.44]

Bulk Density: by the soil clod method using Saran (C.S.S.C. 1978c) The samples were oven dried and weighed. Calculations were based on air dry volume. Values reported are the arithmetic mean of 3 to 5 determinations per horizon. [2.221]

FIELD TESTS

Percolation: by the method suggested by the Alberta Department of Manpower and Labour (1972). This consists of digging a hole to the depth of interest followed by saturation for 24 hours before measuring the rate of drop of the water level in the hole.

Infiltration: by the double ring method with a constant head apparatus as suggested by Adams et al. (1957).

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[1] The numbers in [] indicate the method in C.S.S.C. (1978c).

METHODS OF VEGETATION DESCRIPTION AND ANALYSIS

FIELD SAMPLING

Since a prime objective of the vegetation study was to provide information for the Ecological Land Classification, the methods were subject to the constraints of a 1:50,000 mapping program. Polygons of homogeneous composition were initially outlined on air photos. Single sample plots were then established in homogeneous areas representative of the predominant vegetation of selected polygons. Plots were generally 20 x 20 m in forested vegetation, 15 x 15 m in shrubby vegetation and 10 x 10 m in herbaceous and dwarf shrub vegetation. Smaller plots (5 x 5 m or 1 x 1 m) were sometimes necessary to keep plot boundaries within a homogeneous area, as in some intricately patterned Alpine areas.

Within each plot, canopy cover was estimated to the nearest percent both for individual species and for each layer. Epiphyte cover was not estimated; species were merely noted as being present. Five layers were recognized: 1) Tree layer: woody plants >5 m tall, 2) Tall Shrub layer: woody plants 2 to 5 m tall, 3) Low Shrub layer: woody plants 0.5 to 2 m tall, 4) Herb-Dwarf Shrub layer: woody plants <0.5 m tall and all herbs regardless of height, and 5) Bryoid layer: terrestrial lichens and bryophytes. Cover values were also estimated for ground litter, rocks and stones, mineral soil, deadfall, and water. Usually, one of the largest trees in the plot was measured for height and diameter at breast height (dbh) and cored to determine its age. Average tree canopy height and the mean and range of dbh were also estimated.

Physical environmental factors noted included: elevation, slope, aspect, topographic position, relief shape, landform, soil subgroup and drainage class. Each plot was also rated on a moisture regime scale (Table 4).

Table 4. Ecological moisture regime classes (Walmsley et al. 1980).

Class	Usual Soil Drainage
xeric - very dry, little precipitation or high evapotranspiration, very low available water storage capacity (AWSC)	very rapid
subxeric - dry, low AWSC	rapid
mesic - moist, intermediate to high AWSC	well to moderately well
subhygric - moist to wet, variable AWSC, seasonal seepage	imperfect
hygric - wet, variable AWSC, permanent seepage	poor
subhydric - wet, variable AWSC, excess water most of time	very poor
hydric - very wet, standing water constantly	

VEGETATION CLASSIFICATION

The vegetation was initially classified into five physiognomic classes: Closed Forest (C), Open Forest (O), Shrub (S), Low Shrub-Herb (L), and Herb-Dwarf Shrub (H). In Closed Forests, the distance between tree crowns is no more than twice the mean crown diameter. This generally corresponds to a lower tree cover limit of 15 to 20%. In Open Forests, the distance between crowns is 2X to 5X the mean crown diameter and tree cover is generally between 5% and 15 to 20%. Vegetation with <5% tree cover was not considered forested. Within these physiognomic classes the classification was based primarily on the dominant species in each layer and on characteristic combinations of species. Dominance or importance was determined by cover values and thus, the classification has a quantitative basis. The plots were grouped on the basis of shared characteristics into abstract units called vegetation types (v.t.s). The v.t. is of the same order of magnitude as the "association" of the Zurich-Montpellier approach (Westhoff and van der Maarel 1973) or the "biogeocoenose" of Sukachev (Sukachev and Dylis 1964), although the bases and methods of recognition differ. Both seral and climax v.t.s were recognized. The species used to name the v.t.s were usually layer dominants. A hyphen (-) separates species in the same layer; a virgule (/) separates layers.

METHODS OF WILDLIFE DESCRIPTION AND ANALYSIS

SAMPLING RATIONALE

A wide variety of methods was chosen to collect data on the seasonal abundance, distribution and habitat characteristics of all species of mammals, birds, amphibians and reptiles that occur in Banff and Jasper National Parks. The broad scope of the inventory and the large area necessitated a variety of approaches to data collection. The sampling methods were fast, simple and quantitative. Some methods were directed specifically at relating wildlife abundance to the ecological land classification and these are described here. Other methods were used to survey the seasonal movements of selected species, to determine the densities of some species, and to locate less common wildlife species. These methods are detailed in Volume III.

Four methods were used to relate wildlife occurrence to each Ecosite. The main considerations in selecting these methods were:

1. Each sample area must be small enough to fit entirely within one map polygon. The maximum area sampled was 500 m x 500 m.
2. Each method must require minimal time, effort or equipment and allow a limited number of staff to sample a large number of sites over a wide area of rugged terrain.
3. Each method must be quantitative and easily taught to new staff.

The techniques selected were pellet group counts with forage use plots, track count transects, call count transects and snap traplines.

DESCRIPTION OF METHODS

Breeding bird populations were sampled by counting birds along 500 m transects before 9:00 a.m. between June 1 and July 15. The number of birds recorded was corrected for detectibility (Emlen 1971) and density indices were calculated for all transects on each Ecosite. Cluster analyses were used to identify bird communities which were then related to each Ecosite. Red squirrel numbers were also assessed using this method.

The relative abundance of small mammals on each Ecosite was determined using traplines of 100 *Woodstream Museum Special* traps baited for two nights. The number of rodents and shrews that were caught was averaged for each Ecosite. The averages were used in a cluster analysis to identify associations of small mammals.

The relative importance of each Ecosite to each ungulate species was determined by counting pellet groups. Each count was conducted over 25 quadrats (2 m x 5 m) spaced 50 m apart in 5 rows of 5 quadrats each. The number of pellet groups of each species was multiplied by 40 to give the number of pellet groups per km² and the average density was calculated for each Ecosite and vegetation type. The number of snowshoe hare pellets was counted in each corner 0.5 m x 0.5 m of each quadrat. These counts were multiplied by 400 to yield the density of hare pellets per km². On some pellet group sample sites the vegetation was also surveyed. At these sites, the abundance of the six most common plants was noted in each quadrat and use of any plants was recorded as a percentage of the plants eaten. The results were tallied for all quadrats on each Ecosite and vegetation type. This information was used to identify major forage plants on each Ecosite and to partially explain the importance of an Ecosite to ungulates.

Winter mammal activity was assessed by counting the number of tracks intercepted by a straight transect of 0.5 km or longer. Track counts were standardized to the mean number of tracks per 10km-day by dividing the total track count by the total distance of the transects and the number of days since the last snowfall. These figures were averaged for each Ecosite and vegetation type. Snow depth measurements were made on most transects. In addition, all birds seen or heard were recorded.

ECOLOGICAL INTEGRATION ANALYSIS

The above four methods were the primary sampling techniques for relating the abundance of wildlife to each Ecosite and vegetation type. The numerical values derived from each method are not presented here. Instead, the values were ranked in numerical order and rated as follows: the lowest third were rated as Low, the second third as Medium, the top third as High, and the top 5-8% as Very High. These ratings were then assigned to the corresponding Ecosites. Separate ratings were derived for each carnivore and ungulate species, since the range of values for each species varied greatly depending on the species' abundance and the degree to which it occurred in groups. For small mammals and breeding birds, rating schemes were developed for species groups. This was because of the large number of species involved and the lack of species-specific management in the national parks.

Thus, for each species or species group, the importance of an Ecosite is considered to be directly comparable to the measured relative abundance of that species on an Ecosite. Critical habitats are the highly and very highly ranked Ecosites and vegetation types, in addition to habitats with special functions (e.g. denning, calving or staging). It is important to note that some critical areas may be site-specific and not predictable by habitat designation. Thus, random observations and site visits should be included in any site-specific analysis of wildlife.

An additional method of ranking Ecosites was devised for lynx, coyotes, wolves and cougars since relatively few tracks of these species were recorded. From other studies of their food habits, a ranking scheme was created based on the importance of each Ecosite to their prey species weighted by the proportion of the prey in each predator's diet. For further details see Volume III.

In this volume the importance of each Ecosite to wildlife is briefly discussed. Generally, only the species for which the Ecosite is highly or very highly important are identified. Factors that result in the importance rating, such as snow depth, forage abundance and prey availability are discussed briefly. In addition, for ungulates and carnivores, a single rating of importance is presented for each Ecosite. This rating is derived from the sum of the individual species ratings. It is not intended to be used for site specific planning or management but for planning at the park level or larger.

CHAPTER II - DESCRIPTION OF THE STUDY AREA

LOCATION AND PHYSIOGRAPHY	W.S. Taylor and D.T. Allan
CLIMATE	B.D. Walker and W.D. Holland
GEOLOGY	W.S. Taylor
GEOMORPHOLOGY	B.D. Walker
SOILS	B.D. Walker, W.D. Holland and G.M. Coen
VEGETATION	P.L. Achuff and I.G.W. Corns
WILDLIFE	G.L. Holroyd and K.J. Van Tighem

LOCATION AND PHYSIOGRAPHY

INTRODUCTION

Banff and Jasper are situated within the Continental Ranges of the Southern Rocky Mountains, part of the Eastern System of the Cordilleran region of Canada (Bostock 1970). The parks form a crude northwest-southeast trending parallelogram that extends 425 km from about 53°30′ N and 119°30′ W to 50°40′ N and 115°20′ W. The approximate area of Jasper is 10,880 km^2, while Banff is 6,640 km^2.

Physiographic features of Banff and Jasper are strongly controlled by structure of the Front and Main Ranges geologic subprovinces. Both they and their features trend in the same direction mentioned above. The Front Ranges typically have steeply dipping strata that produce linear ridges of resistant rock separated by subparallel valleys carved from softer rock. Bedrock dips steeply southwest, providing long, smooth slopes on this aspect and precipitous cliffs on northeast aspects. The Main Ranges strata, for the most part gently dipping, produce nonlinear ranges with high individual or clustered peaks capped by resistant rock.

Peak elevations generally increase from east to west and are highest in the vicinity of the Columbia Icefield, reaching over 3700 meters. The lowest elevation, 990 meters, occurs where the Athabasca River exits Jasper.

DRAINAGE AND HYDROLOGY

Banff and Jasper abut the Continental Divide and are part of the headwaters for the Peace, Athabasca, and Saskatchewan River Systems. The mountains comprise about one-eighth of the drainage area but supply about seven-eighths of the total annual flow of the Saskatchewan River System. In the parks, approximately 50 percent of mean annual precipitation contributes to mean annual runoff, and about 70 percent of total annual flow occurs from June through August (Hanson n.d.) Flooding potential from rapid snow melt or a heavy storm is greatest during this period.

Stream gradients vary from 80 m/km or more in steep terrain to 0.13 m/km for the Bow River just above Banff townsite. Stream courses and gradients are strongly controlled by topography.

Lakes are also controlled by topography, though Lake Minnewanka, the largest lake in Banff, was created for hydroelectric power production. Other lakes are dammed by natural means (e.g. landslides, moraines, fans) or are in natural depressions such as kettles. Where accessible, they are important for recreation.

Subsurface flow is important, especially in areas of limestone, such as the spectacular example of karst between Medicine Lake and Maligne Canyon in Jasper (Brown 1973). Hot springs occur in both Banff and Jasper, and discovery of the Cave and Basin near Banff townsite in 1883 led to the creation of Canada's first National Park.

SURFACE EXPRESSION

Main physiographic features of Banff and Jasper may be traced to mountain building processes and subsequent erosion, with the Pleistocene glaciation a significant event. Vestiges of this glaciation and the processes involved are still active in the glaciers and icefields at high elevations that chiefly occur near the Continental Divide. Both glacial and postglacial surface features are described in the geomorphology section the Ecosite descriptions, and the legends.

PHYSIOGRAPHY AND PEOPLE

Physiography affects land use in the parks in many ways. Self-evident relationships include:

1. amenable topography and climate that make the Montane Ecoregion subject to the most intense land use in the parks
2. the passes providing transportation and utility corridors with attendant land use pressures
3. the combined influence of structure and glaciation that results in aesthetic lakes in cirques on the eastern sides of individual ranges, thus attracting development.

CLIMATE

OVERVIEW

Climatic data for Banff and Jasper National Parks are scarce. Janz and Storr (1977) provide the most comprehensive climatic overview for the contiguous National Parks within the Canadian Rocky Mountains.

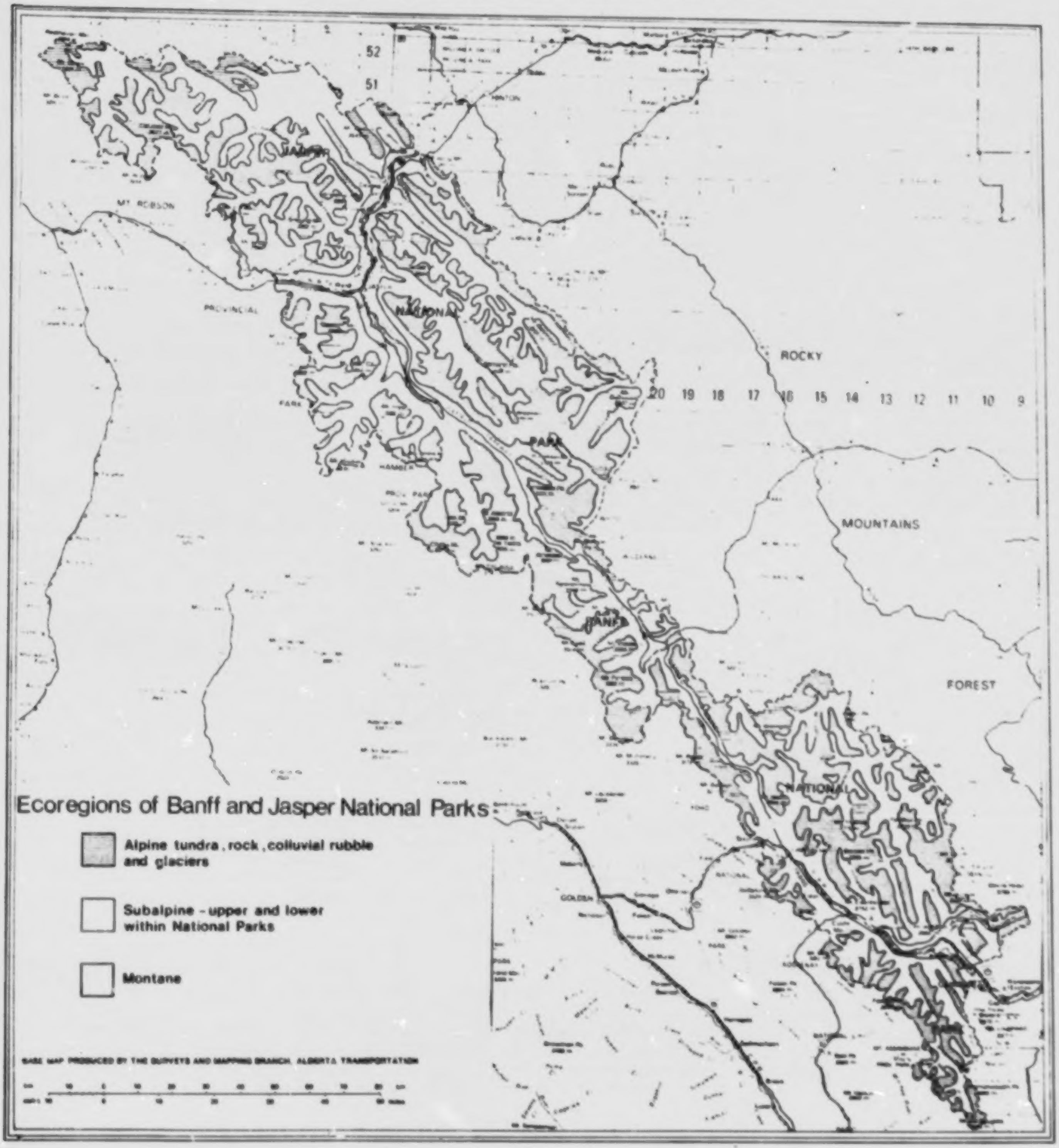
The macroclimate of Banff and Jasper is continental with long winters which can be cold and short summers that are cool with occasional hot spells. According to Koeppen's climatic classification (Trewartha 1957) most valley floors and lower slopes have a Dfc climate (Cold Snowy Forest Climate with no distinct dry season; cool short summers).

Both parks are subject to the same air masses and weather systems that migrate across western Canada at mid-latitudes. However, the mountain topography modifies macroclimate creating mesoclimatic and microclimatic gradients. The predominant northwest-southeast orientation of mountain ranges and valleys is nearly perpendicular to the prevailing winds aloft and influences precipitation distribution, winds, and the intrusion of Arctic air from the prairies to the east. Topography, especially aspect and elevation, causes climatic variation over short distances.

CLIMATE AND ECOREGIONS

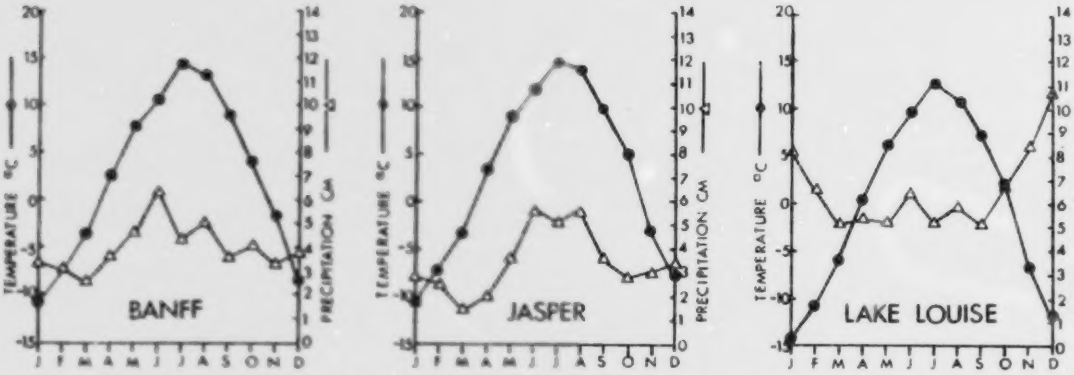
Lack of sufficient climatic data makes it impossible to classify Banff and Jasper, at scales of 1:250,000 and larger, using climatic data solely. However, vegetation, as a biotic component of an ecosystem, reflects climate. Thus, vegetation differences at a high level of generalization have been used to indicate climatic units. Based primarily on vegetation physiognomy and composition, four units have been delineated: Montane Ecoregion, Subalpine Ecoregion with Lower Subalpine and Upper Subalpine subunits, and Alpine Ecoregion. An approximation of their distribution is shown in Fig. 2.

Fig. 2. Ecoregions of Banff and Jasper National Parks.


52
51
MT. ROBSON
PROVINCIAL
PARK
NATIONAL
PARK
BANFF
NATIONAL
GOLDEN
ROCKY
MOUNTAINS
FOREST
20 19 18 17 16 15 14 13 12 11 10 9
Ecoregions of Banff and Jasper National Parks
Alpine tundra, rock, colluvial rubble and glaciers
Subalpine - upper and lower within National Parks
Montane
BASE MAP PRODUCED BY THE SURVEYS AND MAPPING BRANCH, ALBERTA TRANSPORTATION

The most complete climatic data are available for the Montane Ecoregion. Fig. 3 illustrates temperature and precipitation data for Banff and Jasper townsites, both located in the Montane, and Village Lake Louise, located in the Lower Subalpine.

Fig. 3. Mean monthly temperature and precipitation for Banff and Jasper townsites and Village Lake Louise.



THE MONTANE ECOREGION

The climate of the Montane Ecoregion is the warmest and driest in the two parks. Mean yearly temperature is 2° to 3° C, based on Banff and Jasper townsite data. Average annual precipitation is about 465 mm (Tables 5 and 6) with summer precipitation being slightly greater than winter precipitation (Fig. 3).

Although the Montane is generally the warmest Ecoregion, it probably has the greatest temperature fluctuation. Extreme minimum temperatures in the range of −50° to −54° C (such low temperatures are rare) have been experienced in the main valleys below 1500 m (Janz and Storr 1977). These are related to temperature inversions with little mixing by wind and invasion of cold Arctic air from the north. Extreme maxima are of the order of 38° C in valleys below 1200 m but temperatures above 32° C are relatively rare (Janz and Storr 1977). Frequency of summer frost in the Montane is low and also indicates relatively mild climate.

Winds in the Montane are slightly stronger and more frequent than in other areas because valleys mapped as Montane are oriented approximately parallel to the prevailing westerlies aloft. Warm winter winds (chinooks) from Pacific air masses raise winter temperatures and the Montane Ecoregion is intermittently snowfree.

THE SUBALPINE ECOREGION

The Subalpine Ecoregion occurs at elevations above the Montane Ecoregion and is cooler and moister. The mean yearly temperature is about 0° C at low elevations, based on the Village Lake Louise data, and decreases with increasing elevation (i.e. about 0.5° C/100 m; summer lapse rate). Precipitation increases with elevation and the average annual precipitation of the Upper Subalpine (763 mm) is greater than the Lower Subalpine (665 mm), based on data from a few stations (Tables 5 and 6). Winter precipitation is greater than summer precipitation (Fig. 3) and the

Table 5. Average annual preciptation, October 1966 to September 1980, for stations in Banff National Park.

Station	Type of Gauge [a]	Elevation (m)	Latitude	Longitude	No. Years Observation	Precipitation Avg./Yr. (mm)	Ecoregion
Banff	1	1397	51° 11′	115° 34′	14	455	Montane
					X̄=	455	
Howse R. Cabin	2	1494	52° 03′	116° 47′	10	492	Lower Subalpine
Alexandra R. Cabin	2	1494	52° 03′	117° 07′	10	582	
Lake Louise	1	1533	51° 25′	116° 10′	14	569	
Brewster Ck. (headwaters)	2	1575	51° 08′	115° 41′	9	747	
Cascade Lem	2	1646	51° 20′	115° 35′	6	490	
Waterfowl Lake	2	1793	51° 51′	116° 38′	10	711	
Sarbach L.O.	2	1829	51° 55′	116° 45′	13	719	
Temple Lodge	2	1890	51° 26′	116° 09′	14	667	
					X̄=	662	
Bow Summit	2	2070	51° 43′	116° 27′	14	728	Upper Subalpine
Alexandra L.O.	2	2043	52° 06′	116° 55′	10	773	
Fatigue	2	2143	51° 01′	115° 40′	9	875	
Snowflake I.J.P.	2	2210	51° 38′	115° 50′	6	523	
Sunwapta (Nigel Ck.)	2	2256	52° 12′	117° 07′	14	814	
					X̄=	742.6	

a Type of Gauge

1 Daily
2 Sacramento Storage Gauge (usually recorded twice a year)

Table 6. Average annual precipitation, October 1966 to September 1980, for stations in Jasper National Park.

Station	Type of Gauge a	Elevation (m)	Latitude	Longitude	No. Years Observation	Precipitation Avg./Yr. (mm)	Ecoregion
Jasper East Gate	1	1003	53° 14′	117° 49′	14	619	Montane
Warden Station (U. of A.)	2	1024	52° 48′	118° 08′	6	361	
Jasper (townsite)	1	1061	52° 53′	118° 04′	14	383	
Jasper West Gate	1	1127	52° 52′	118° 23′	5	571	
Athabasca Falls	1	1181	52° 40′	117° 53′	6	421 $\overline{X}$=471	
Miette Hot Springs	1	1341	53° 08′	117° 46′	6	827	Lower Subalpine
	2	1341	53° 08′	117° 46′	10	684	
Willow Creek	2	1402	53° 23′	118° 21′	8	422	
Smoky River Warden	2	1463	53° 22′	119° 16′	9	701	
Sunwapta Warden	1,2	1554	52° 27′	117° 27′	9	797	
Signal 4	2	1677	52° 53′	117° 59′	6	586	
Pyramid 4	2	1677	52° 58′	118° 07′	6	801	
Athabasca Pass	2	1745	52° 23′	118° 11′	4	1561*	
Topaz Lake	2	1758	53° 23′	118° 48′	8	524	
Brazeau Warden	2	1768	52° 24′	117° 01′	9	438	
Rocky Forks	2	1840	52° 50′	117° 24′	8	622	
Maligne Lake	2	1845	52° 44′	117° 38′	10	565 $\overline{X}$=710.7	
Amethyst Lake	2	1966	52° 42′	118° 16′	8	974	Upper Subalpine
Columbia Icefields	1	1981	52° 41′	117° 10′	7	792	
Marmot Basin	2	1982	52° 47′	118° 07′	10	742	
Pyramid 5	2	2043	52° 58′	118° 07′	6	713	
Signal 2	2	2043	52° 52′	117° 59′	6	691 $\overline{X}$=782.4	
Pyramid Mountain	2	2767	52° 57′	118° 08′	10	595	Alpine

***Excluding Athabasca Pass station $\overline{X}$ = 633.4**

a Type of Gauge:

- **1 Daily**
- **2 Sacramento Storage Gauge (usually recorded twice a year)**

incidence of measurable summer snowfall is greater than in the Montane. Precipitation in eastern portions of the parks appears to be lower than in western regions. This trend is supported by the scattered occurrence of Cryosolic soils (Achuff and Coen 1980) and dry grassland and shrubland vegetation in eastern subalpine areas. Conversely, Janz and Storr (1977) describe the area from Athabasca Pass to Freshfield Icefield (the Icefields area) as having an abnormally high precipitation regime relative to other areas of the parks.

Temperature fluctuation is narrower in the Subalpine than in the Montane. Janz and Storr (1977) indicate that the occurence of extreme minima in the -48° to -54° C range is rare above 1500 m elevation. Extreme maximum temperatures are lower than in the Montane because of a decrease with elevation that is probably similar to the lapse rate of mean maximum temperature (i.e. about 0.7° - 0.8° C/ 100 m, Janz and Storr 1977). Data from Bow Pass (6 years record, Janz and Storr 1977) and Mt. White (2.5 years record) in Banff indicate extreme maxima of 28° to 29° C in the Upper Subalpine at 1850 to 1970 m elevation.

Winds are generally light in the Subalpine, although there is evidence of wide variation, related mostly to topography. Thus, winds are important in east-west trending valleys and passes that traverse the mountain ranges, and also at higher elevations as indicated by stunted and krummholz open forest, and on exposed nonforested localities such as grasslands.

THE ALPINE ECOREGION

The Alpine Ecoregion occurs at elevations above the Subalpine Ecoregion and is the coldest in Banff and Jasper. Cool mean temperature projections are based on the trends of temperatures at lower elevations. Likewise, the temperature range is narrower in the Alpine (Janz and Storr 1977). This trend also extends to extreme maxima and minima. Precipitation increases with altitude from the Montane Ecoregion upward into the Alpine, but somewhere in the Alpine the trend may reverse. The lack of forest vegetation demonstrates the rigorous climate of the Alpine Ecoregion.

Winds are important in the Alpine. Janz and Storr (1977) report that all areas above about 2300 m are windy but winds may be light for several days in succession, particularly in summer. Erodible, exposed surfaces are often deflated and snow is redistributed by wind. Complex vegetation patterns in the Alpine are often linked to varying topographic exposures and resultant snow depth variability.

GEOLOGY

INTRODUCTION

Banff and Jasper lie in the southern portion of the Rocky Mountain Thrust Belt, the southeasterly-most sector of Canada's Cordilleran Orogen. This orogen represents the present state of evolution of the Cordilleran Geosyncline. Regional setting and stratigraphic and structural frameworks are outlined by Douglas et al. (1970) and Price and Mountjoy (1970a).

STRATIGRAPHIC FRAMEWORK AND ECOLOGICAL LAND CLASSIFICATION

Three categories of bedrock in Banff and Jasper are significant to this Ecological Land Classification. These are:

1. noncalcareous, medium and coarse grained clastic
2. noncalcareous, medium and fine grained clastic
3. carbonate and calcareous clastic.

This grouping was chosen because of the influence of these lithologies on unsorted genetic materials (Table 7) The stratigraphic column and named Groups and Formations in which these lithologies occur are shown in Fig. 4.

Table 7. Correlation of generalized bedrock lithology with calcareousness and textural groups of unsorted genetic materials.

Generalized Bedrock Lithology	Calcareousness and Texture of Unsorted Genetic Material
Noncalcareous, medium and coarse grained, clastic	Noncalcareous, coarse textured
Noncalcareous, medium and fine grained, clastic	Noncalcareous, medium textured
Carbonate and or calcareous clastic	Calcareous, medium textured

STRUCTURAL FRAMEWORK AND ECOLOGICAL LAND CLASSIFICATION

Orogeny and subsequent erosion has produced four northwest-southeast trending geological subprovinces in the Rocky Mountains, only two of which are well expressed in Banff and Jasper. Regional stratigraphy, structure, and topography distinguish these subprovinces, and distribution is shown in Fig. 5. Typical Foothills subprovince essentially does not occur in the parks. The Front Ranges subprovince is regionally represented by southwest dipping Devonian to Jurassic rocks arranged in subparallel ridges of resistant Paleozoic carbonate separated by valleys carved from recessive Mesozoic clastics. Regionally, Main Range beds are gently dipping and the mountain ranges are not linear. Typically, peaks are capped by pre-Devonian carbonates and grade downwards in time with decreasing elevation to clastics of the early miogeosyncline (Fig. 4).

Some Ecosites have a direct link to a specific geological setting. For instance, the source strata for an Ecosite mapped on noncalcareous, medium textured till located in the Main Ranges were probably of the Miette Group (Figs. 4, 5, Table 7). Distribution of certain Ecosites correlates closely with distribution of Groups and Formations as shown on maps prepared by the Geological Survey of Canada. Geological maps complementing this Ecological Land Classification are by Price and Mountjoy (1970a,b), (1971a,b,), (1972a,b), Cook (1975), Price et al. (1978), Price et al. (1979), and Mountjoy (1980).

GEOMORPHOLOGY

INTRODUCTION

Soil and vegetation development is influenced by landform. Landform classes are defined in terms of genetic material, surface expression, and modifying processes (C.S.S.C. 1978b). Genetic materials are emphasized in this section and are classified, with some modifications to taxa definitions, according to the C.S.S.C. (1978b) landform classification system.

Genetic materials are organized into four groups: consolidated (bedrock), unconsolidated mineral, organic, and ice. The unconsolidated mineral group is subdivided according to mode of formation or deposition. Ten genetic material classes (modified from C.S.S.C 1978b) are recognized. These are listed in Table 4 in order of increasing source diversity, increasing influence of depositional agents, and decreasing influence of bedrock lithology.

Fig. 4. Generalized time scale and stratigraphic column for Banff and Jasper.

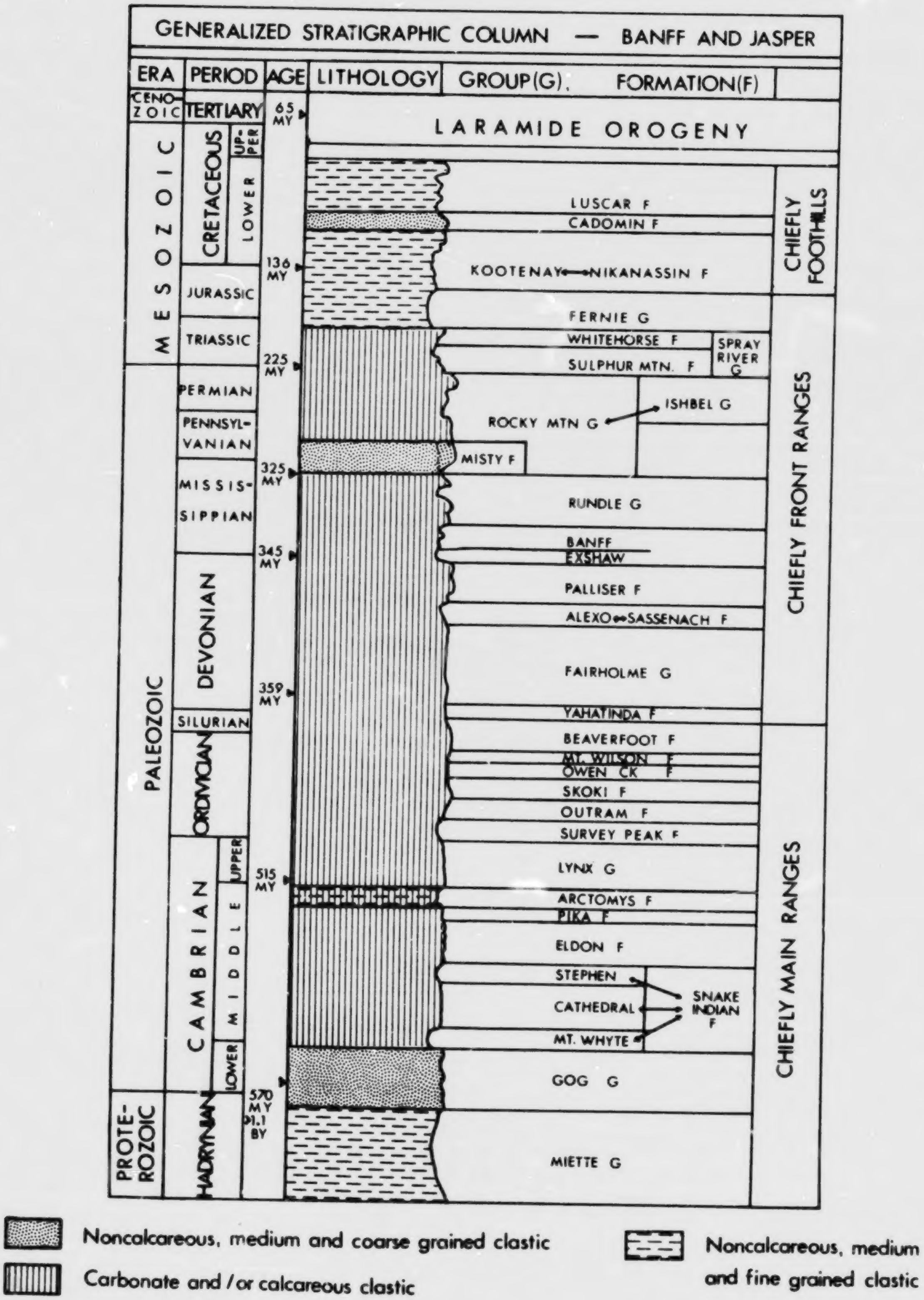
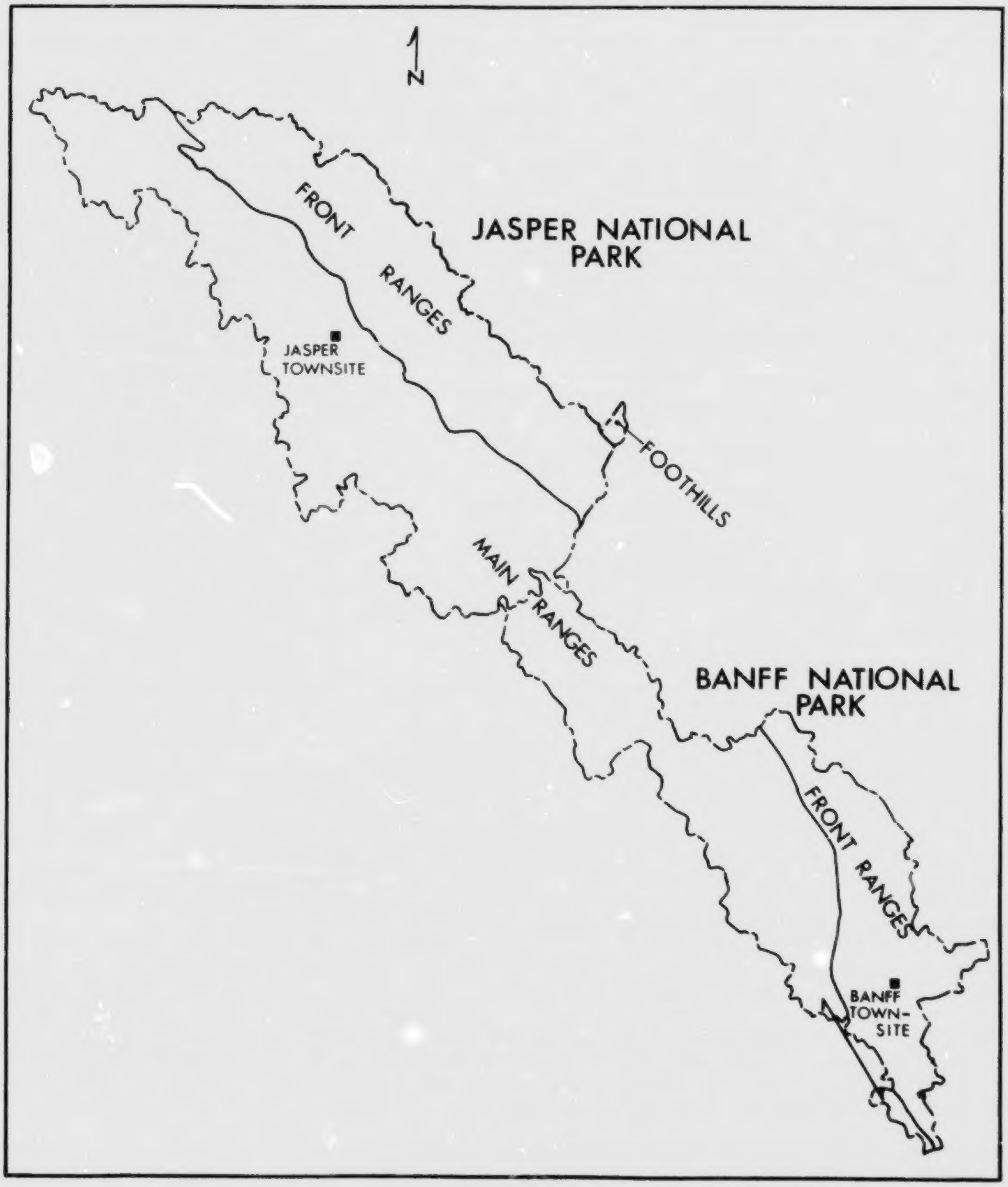

GENERALIZED STRATIGRAPHIC COLUMN — BANFF AND JASPER
ERA
PERIOD
AGE
LITHOLOGY
GROUP(G), FORMATION(F)
CENOZOIC
TERTIARY
65 MY
LARAMIDE OROGENY
MESOZOIC
CRETACEOUS
UPPER
LOWER
LUSCAR F
CADOMIN F
136 MY
KOOTENAY↔NIKANASSIN F
CHIEFLY FOOTHILLS
JURASSIC
FERNIE G
TRIASSIC
WHITEHORSE F
SULPHUR MTN. F
SPRAY RIVER G
225 MY
PERMIAN
PENNSYLVANIAN
ROCKY MTN G
ISHBEL G
MISTY F
325 MY
MISSISSIPPIAN
RUNDLE G
345 MY
BANFF
EXSHAW
PALLISER F
DEVONIAN
ALEXO↔SASSENACH F
FAIRHOLME G
359 MY
CHIEFLY FRONT RANGES
PALEOZOIC
YAHATINDA F
SILURIAN
BEAVERFOOT F
ORDOVICIAN
MT. WILSON F
OWEN CK F
SKOKI F
OUTRAM F
SURVEY PEAK F
CAMBRIAN
UPPER
LYNX G
515 MY
MIDDLE
ARCTOMYS F
PIKA F
ELDON F
STEPHEN
CATHEDRAL
SNAKE INDIAN F
MT. WHYTE
LOWER
GOG G
CHIEFLY MAIN RANGES
570 MY
>1.1 BY
PROTEROZOIC
HADRYNIAN
MIETTE G
▨ Noncalcareous, medium and coarse grained clastic
▥ Carbonate and / or calcareous clastic
☰ Noncalcareous, medium and fine grained clastic

Fig. 5. Geologic subprovinces of Banff and Jasper.


N
JASPER NATIONAL PARK
FRONT RANGES
JASPER TOWNSITE
FOOTHILLS
MAIN RANGES
BANFF NATIONAL PARK
FRONT RANGES
BANFF TOWN-SITE

Genetic material classes are further subdivided according to textural and chemical (calcareousness) properties imparted either by source area lithology or modified by depositional media. Twenty genetic material units, listed in Table 8, are defined specifically for the Banff-Jasper Ecological Land Classification.

Table 8. Characteristics of modal unconsolidated mineral genetic materials.

	Medium	Genetic Material Symbol*	Genetic Material Class†		Characteristics			Genetic Material Unit
					Calcareousness		Texture	
Genetic material derived from increasingly diverse bedrock lithology	Rock *(in situ and failed)*	R^{U*}	Residual	*Restricted bedrock source*	noncalcareous		medium	Residuum A
					calcareous		medium	Residuum B
	Gravity	C^{A*}	Landslide		variable	*Unsorted*	variable	Landslide material
		C	Colluvial		noncalcareous		coarse	Colluvium A
					noncalcareous		medium	Colluvium B
					calcareous		medium	Colluvium C
	Ice	M	Morainal		noncalcareous		coarse	Till A
					noncalcareous		medium	Till B
					calcareous		medium	Till C
		MF^{G*}	Ice Contact Stratified		noncalcareous		coarse	Ice Contact Stratified Drift A
					calcareous		variable	Ice Contact Stratified Drift B
	Flowing Water	F^{G}	Glaciofluvial	*Increasingly diverse sources*	noncalcareous	*Increasingly sorted*	coarse	Glaciofluvial material A
					calcareous		coarse	Glaciofluvial material B
		F	Fluvial		noncalcareous		coarse-stratified	Fluvial material A
					calcareous		coarse-stratified	Fluvial material B
	Still Water	F^{L*}	Fluviolacustrine		altered		fine-stratified	Fluviolacustrine material A
					calcareous		fine-stratified	Fluviolacustrine material B
		L^{G}	Glaciolacustrine		calcareous		fine	Glaciolacustrine material
	Air	E	Eolian		calcareous		medium	Eolian material A
					altered		medium	Eolian material B

* The abbreviations used to designate Genetic Materials are according to C.S.S.C. 1978b except for R^U, C^A, MF^G, and F^L which are defined in this section.

† Modified from C.S.S.C. (1978b).

RESIDUAL GENETIC MATERIAL

Residual material in Banff and Jasper is physically and chemically weathered bedrock and is designated by landform symbol R^U. It includes failed bedrock that retains some original bedding structure and is nonfragmental. Residual material is derived from recessive, medium and fine grained, clastic bedrock. It may be either noncalcareous or calcareous and is divided into two genetic material units (Residuum A and Residuum B) on that basis.

Residuum A is normally medium textured and noncalcareous (acidic), with dominant characteristics as presented in Table 9. It is the dominant residual material of the Main Ranges. Residuum B is normally medium textured and calcareous, hence neutral to moderately alkaline in reaction (Table 9). It is distributed primarily in the Front Ranges. Fine earth content decreases and coarse fragment content increases with depth in sola developed in both residual materials. Residuum A is defined as having sola with pH $\leq$ 5.5 to a depth of 25 cm below the top of the B horizon. Residuum B is associated with sola having pH > 5.5.

Surface expression of both residual materials is inclined, hummocky, or ridged depending on the nature of the underlying bedrock and whether or not slope failure has occurred. Slopes commonly range to 45%. Solifluction and cryoturbation are common modifying processes in the

Table 9. Characteristics of residual genetic material units.

Genetic Material Unit	Dominant Source	Usual Textural Properties		Usual Chemical Properties	
		Fine Earth	Coarse Fragments	Calcareousness	pH
Residuum A	Noncalcareous, medium to fine grained, clastic bedrock (e.g. Miette Group)	20-60% sand and 5-20% clay	50-90%	Noncalc.	4.5-6.0
Residuum B	Calcareous, medium to fine grained, clastic bedrock (e.g. Spray River Group)	20-60% sand and 5-20% clay	50-90%	<35% $CaCO_3$ equiv.	7.0-8.0

Alpine Ecoregion.

LANDSLIDE GENETIC MATERIAL

Landslide genetic material in Banff and Jasper is generated by rapid, gravity-induced movement of mineral material downslope en masse. It is designated by the landform symbol c^A and represents a subset of colluvial material as defined by C.S.S.C. (1978b). Landslides are sporadically distributed throughout the parks and consist of failed bedrock of various lithologies. Occasionally they originated from unconsolidated mineral material.

Coarse fragments comprise 50 to 100% of the material by volume and are rubbly (angular fragments <256 mm) and blocky (angular fragments >256 mm). Most landslides are fragmental at depth. Surfaces are often exceedingly to excessively stony. Fine earth textures vary from medium to coarse, spanning the silt loam, loam, sandy loam, and loamy sand textural classes defined by C.S.S.C. (1978a). Much of the fine earth fraction in soils on older slides is Eolian Material B. Soil and vegetation develop more rapidly on finer grained slides, while coarsest portions have sparse soil and vegetation regardless of age. Calcareousness ranges from non to extremely calcareous. Both extremes may occur within one slide derived from contrasting materials.

Surface expression of landslide material is hummocky, often superimposed on a rising, inclined slope. Hummocks are produced by the landslide process, while the overall incline reflects bedrock control at some depth. Other genetic materials, especially morainal material on valley walls and floors, many underlie landslides at variable depth.

COLLUVIAL GENETIC MATERIAL

Colluvial genetic material in Banff and Jasper is generated by the slow or rapid, gravity induced, downslope displacement of isolated mineral fragments. It is designated by the landform symbol c and represents a subset of colluvial material as defined by C.S.S.C (1978b). Soil creep and snow avalanching, with avalanche related fluvial activity including mudflows, are the processes responsible for colluvial material accumulation. This material is generally postglacial and mantles steep valley walls. Three colluvial genetic material units (Colluvium A,B, and C) are distinguished based on textural and chemical properties (Table 10).

Table 10. Characteristics of colluvial genetic material units.

Genetic Material Unit	Dominant Source	Usual Textural Properties		Usual Chemical Properties	
		Fine Earth	Coarse Fragments	Calcareousness	pH
Colluvium A	Noncalcareous, medium to coarse grained, clastic bedrock (e.g. Gog Group quartzites)	60-85% sand and 0-10% clay	50-90%	Noncalc.	4.3-6.0
Colluvium B	Noncalcareous, medium to fine grained, clastic bedrock (e.g. Miette and Fernie Groups)	20-60% sand and 5-20% clay	35-90%	Noncalc.	4.3-6.0
Colluvium C	Medium to fine grained, carbonate and calcareous clastic bedrock	20-60% sand and 0-25% clay	35-90%	30-95% $CaCO_3$ equivalent	7.0-7.8

Colluvium A is normally coarse textured and noncalcareous (acidic). It is most extensive in the Main Ranges. Colluvium B is normally medium textured and noncalcareous (acidic). Colluvium C is usually medium textured and calcareous, hence neutral to mildly alkaline in reaction.

Low lime colluvial materials are differentiated into Colluvium A and B versus C based on pH of the sola developed on them. Colluvium A and B produce sola with pH ≤ 5.5 at a depth of 25 cm below the top of the B horizon. Colluvium C produces sola with pH >5.5. Colluvium that is texturally transitional between Colluvium A and B is distinguished by coarse fragments and soil development. Colluvium A generally has more coarse fragments, than B or C. Colluvium B is characterized by coarse fragments which are dominantly shales and slates. Soils developed on Colluvium A generally have deeply developed sola and thick, well developed eluvial (Ae) horizons. Colluvium B soils have thin sola and thin to absent Ae horizons. Further, the lithology of source bedrock aids in differentiating the colluvial material units.

Surface form is usually linear and expressed as blankets, veneers, and aprons. It is controlled by the amount of deposition and by the underlying bedrock. Slopes commonly range from 45 to 100%; their continuity may be broken by one or more bedrock outcrops. Soil creep and snow avalanching are the most common modifying processes. Slope failure, sheet erosion, solifluction, and cryoturbation occur locally.

MORAINAL GENETIC MATERIAL

Morainal material (till) is unsorted and unstratified drift deposited by and underneath a glacier without subsequent reworking by glacial meltwater. Morainal deposits occur extensively and are designated by the landform symbol M. Morainal topography frequently dominates valley walls, valley floor benchlands, cirque basins, cols, and shoulders. Till is occasionally intimately associated with ice contact stratified genetic material along valley floors. Both are collectively considered glacial deposits. Three morainal genetic material units (Tills A,B, and C) are differentiated by textural and chemical properties (Table 11).

Table 11. Characteristics of morainal genetic material units.

Genetic Material Unit	Dominant Source	Usual Textural Properties		Usual Chemical Properties	
		Fine Earth	Coarse Fragments	Calcareousness	pH
Till A	Noncalcareous, medium to coarse grained, clastic bedrock (e.g. Gog Group quartzites)	60-85% sand and 0-10% clay	35-70%	Noncalc.	4.3-6.0
Till B	Noncalcareous, medium to fine grained, clastic bedrock (e.g. Miette and Fernie Groups)	30-60% sand and 5-25% clay	20-50%	Noncalc.	4.3-6.0
Till C	Medium to fine grained, carbonate and calcareous clastic bedrock	20-60% sand and 5-27% clay	20-50%	15-85% $CaCO_3$ equivalent	7.0-7.8

Till A is normally coarse textured and noncalcareous (acidic). It is most extensive in the Main Ranges. Till B is normally medium textured and noncalcareous (acidic). Till C is usually medium textured and calcareous (neutral to mildly alkaline).

Low lime Tills A and B are differentiated from Till C by having soils with pH ≤ 5.5 at a depth of 25 cm below the top of the B horizon. Till C is characterized by sola with pH >5.5. Till that is near the medium-coarse textural class boundary is recognized as Till A when it is dominated by a high coarse fragment content (most of which are subrounded quartzites). Soils developed on Till A generally have deeply developed sola and thick, well developed eluvial (Ae) horizons. Till B has coarse fragments which are dominantly shales and slates. The lithology of source bedrock further aids in distinguishing the three tills.

Surface form is usually linear on valley walls and forms blankets overlying inclined bedrock. Ridged and hummocky surfaces characterize benchlands, cirques, cols, and shoulders. These most often reflect underlying bedrock but in some areas reflect deposition or postglacial slope failure. Linear slopes reflecting stream erosion are common along some valley floors. Slopes commonly range from 5 to 70%. Slope failure, gullying, and snow avalanching are common surface modification processes that affect morainal landforms. Sheet erosion, soil creep, solifluction, and cryoturbation occur locally, the latter two at high elevations on the medium textured tills.

ICE CONTACT STRATIFIED GENETIC MATERIAL

Ice contact stratified drift is partially sorted material deposited by glacial ice but with concomitant and subsequent reworking, locally, by flowing and ponded glacial meltwater. The result is extreme vertical and lateral textural variability over short distances, except where coarse to medium grained source strata preclude the incorporation of abundant clay and silt sized particles. In essence, ice contact stratified drift, designated by the landform symbol MF, encompasses an intimate, random mixture of morainal, glaciofluvial, and, occasionally, glaciolacustrine sediments individually inseparable at a scale of 1:50,000. Ice contact stratified drift and morainal material (till) are collectively considered glacial deposits. Two ice contact stratified genetic material units (Ice Contact Stratified Drift A and Ice Contact Stratified Drift B) are differentiated primarily on chemical properties and secondarily on textural properties (Table 12).

Table 12. Characteristics of ice contact stratified drift genetic material units.

Genetic Material Unit	Dominant Source	Usual Textural Properties		Usual Chemical Properties	
		Fine Earth	Coarse Fragments	Calcareousness	pH
Ice contact stratified Drift A	Noncalcareous, medium to coarse grained, clastic bedrock (e.g. Gog Group quartzites)	60-100% sand and 0-10% clay	5-70%	Noncalc.	4.3-6.0
Ice contact stratified Drift B	Medium to fine grained, carbonate and calcareous clastic bedrock	0-100% sand and 0-60% clay	5-70%	15-85% $CaCO_3$ equivalent	7.0-7.8

Ice Contact Stratified Drift A is normally noncalcareous (acidic) and coarse textured. It occurs primarily in the Main Ranges. A noncalcareous textured variant, derived primarily from Miette Group slates and shales, occurs in a few areas of the Main Ranges. Ice Contact Stratified Drift B is normally variably textured and calcareous (neutral to mildly alkaline).

Low lime, ice contact stratified materials are differentiated into Ice Contact Stratified Drift A or B based on pH of the sola developed on them. Ice Contact Stratified Drift A produces sola with pH ≤ 5.5 to a depth of 25 cm below the top of the B horizon. Soils associated with this genetic material unit tend to be deeply developed and have thick, well developed eluvial (Ae) horizons. Ice Contact Stratified Drift B produces soils with thin sola that have pH >5.5 to a depth of 25 cm below the top of the B horizon.

Ice contact stratified drift forms moraine-like landforms near valley floors, on valley floor benchlands, and, occasionally, on lower valley wall slopes. Hummocky, ridged, and inclined surface expressions are typical. These may be of strictly depositional origin, reflect the underlying bedrock, or be the result of stream erosion. Channelling (Eroded modifier, C.S.S.C. 1978b) and gullying are the most important modifying processes, the former often influencing landform surface expression. Other modifying processes of a more local distribution include slope failure, snow avalanching, sheet erosion and soil creep.

GLACIOFLUVIAL GENETIC MATERIAL

Glaciofluvial genetic material is deposited by bodies of flowing water in which the flow volume and sediment load are principally controlled by melting glacial ice. It is designated by the landform symbol F^G and is regarded as a proglacial deposit. Two glaciofluvial genetic material units (Glaciofluvial material A and B) are differentiated by chemical properties (Table 13).

Glaciofluvial material A is normally coarse textured and noncalcareous (acidic). Glaciofluvial material B is normally coarse textured and calcareous (neutral to moderately alkaline).

Table 13. Characteristics of glaciofluvial genetic material units.

Genetic Material Unit	Dominant Source	Usual Textural Properties		Usual Chemical Properties	
		Fine Earth	Coarse Fragments	Calcareousness	pH
Glaciofluvial material A	Noncalcareous glacial deposits	60-100% sand and 0-5% clay	35-70%	Noncalc.	4.3-6.0
Glaciofluvial material B	Calcareous glacial deposits	60-100% sand and 0-5% clay	35-70%	>10% $CaCO_3$ equivalent	7.0-8.0

Low lime glaciofluvial materials are differentiated into Glaciofluvial material A or B based on pH of the sola developed on them. Glaciofluvial material A produces sola with pH $\leq$5.5 to a depth of 25 cm below the top of the B horizon. Soils associated with this genetic material unit tend to be deeply developed and have thick, well developed eluvial (Ae) horizons. Glaciofluvial material B produces sola with pH >5.5 to a depth of 25 cm below the top of the B horizon.

Glaciofluvial deposits are distributed on valley floors and lower benchlands primarily in broad valleys at low elevations. Terrace is the most common surface form of stable landforms. Slopes are often complex with the majority of any surface made up of linear terrace treads with <5% slope. Short risers between terrace levels usually have slopes ranging from 30 to 70%. Actively aggrading glaciofluvial deposits have level and fan surface expressions with slopes <5%. Abandoned channels (Eroded modifier, C.S.S.C. 1978b) are often present.

FLUVIAL GENETIC MATERIAL

Fluvial (alluvial) material encompasses sediment deposited by stream channel sedimentation and mudflow processes (Thornbury 1954, Winder 1965, Russell 1972) and is designated by the landform symbol F . Two fluvial genetic material units (Fluvial material A and B) are differentiated based on chemical properties (Table 14).

Fluvial material A normally displays stratified coarse textures and is noncalcareous (acidic). Fluvial material B normally displays stratified coarse textures and is calcareous (neutral to moderately alkaline).

Low lime fluvial materials are differentiated into Fluvial material A or B based on pH of the sola developed on them. Fluvial material A produces sola with pH $\leq$5.5 to a depth of 25 cm below the top of the B horizon. Fluvial material B produces sola with pH >5.5.

Fluvial landscapes are most abundant along valley floors including benchlands. Two surface form groups, both with linear slopes, are characteristic. Level plains (floodplains), with slopes ranging from 0 to 2%, contain the major streams that formed them. Fans and aprons, with slopes ranging from 2 to 45%, occur along the toes of steeper slopes from which their sediments originated. Fluvial veneers and blankets occur in some cirque basin, col, shoulder, and valley floor localities. Active and abandoned channels (Eroded modifier, C.S.S.C. 1978b) are common on fluvial landform surfaces. Snow avalanching and solifluction are other modifying processes, but these occur locally, particularly at high elevations.

Table 14. Characteristics of fluvial genetic material units.

Genetic Material Unit	Dominant Source	Usual Textural Properties		Usual Chemical Properties	
		Fine Earth	Coarse Fragments	Calcareousness	pH
Fluvial material A	Noncalcareous bedrock, residual, landslide, colluvial, and glacial materials	15-90% sand and 0-25% clay, often stratified	0-70%, often stratified	Noncalc.	4.3-6.0
Fluvial material B	Calcareous bedrock, residual, landslide, colluvial, and glacial materials	15-90% sand and 0-25% clay, often stratified	0-70%, often stratified	5-85% $CaCO_3$ equivalent	7.0-8.0

FLUVIOLACUSTRINE GENETIC MATERIAL

Fluviolacustrine material encompasses relatively fine grained sediments deposited by slowly moving water, both glacial and nonglacial. The depositional environment is considered to be low energy fluvial but, by its textural characteristics, fluviolacustrine material does not fit the fluvial definition of C.S.S.C. (1978b). It is designated by the landform symbol F^L. Two fluviolacustrine genetic material units (Fluviolacustrine material A and B) are differentiated by chemical properties and geomorphic environments (Table 15).

Table 15. Characteristics of fluviolacustrine genetic material units.

Genetic Material Unit	Derivation	Usual Textural Properties		Usual Chemical Properties	
		Fine Earth	Coarse Fragments	Calcareousness	pH
Fluviolacustrine material A	Sheet erosion on other genetic materials, local deposition on other surfaces.	0-20% sand and 15-50% clay, often stratified	0-5%	pedogenic alteration	pedogenic alteration
Fluviolacustrine material B	Fluvial erosion of various deposits, low energy deposition on backwater portions of floodplains	0-20% sand and 10-40% clay, often stratified	0-5%	5-70% $CaCO_3$ equivalent	6.8-7.8

Fluviolacustrine material A encompasses fine textured and stratified, chemically altered, slope wash sediment deposited by nonglacial, unconfined water flow. It usually occurs as thin (usually <30 cm), mineral surface veneers overlying morainal, glaciolacustrine, and fluvial landforms with slopes of 0 to 30%. This material usually comprises the upper sola of soils where pedogenic weathering is strongest, hence the altered chemical properties. Fluviolacustrine material A comprised dominantly of reworked, Eolian material B has inherited the latter's primary mineral constituents and therefore, weathering frequently releases high amounts of free iron and aluminum oxide in the upper 30 cm.

Fluviolacustrine material B encompasses calcareous, fine, stratified sediment deposited by ponding of mainly glacial waters on backwater portions of floodplains, similar to those described by Smith (1972), and on delta-like floodplains at the heads of lakes, like those described by Smith (1975). It is the thickest and most stratified of the two fluviolacustrine material units and is confined to broad, valley floor floodplains where it overlies, interbeds with, and locally supplants fluvial and glaciofluvial sedements. Surface expression is level with slopes ranging from 0 to 1%. Slope continuity is frequently broken by numerous, shallow, abandoned and active stream channels meandering across the landscape (Eroded modifier, C.S.S.C. 1978b).

Fluviolacustrine genetic material is texturally similar to glaciolacustrine genetic material but exhibits greater textural variablility, a wider range of bulk density, and incorporation of thin, fibrous organic layers and pockets compared to the latter. Further, fluviolacustrine material is massive whereas glaciolacustrine material often exhibits varving and nonpedogenic subangular blocky structure. Glaciolacustrine material occurs in former lake basins and mantles, as blankets and veneers, gently sloping glacial landforms on benchlands. Fluviolacustrine sediments are associated with glacial, proglacial, and fluvial landforms as described above but these often do not occur in lake basins.

GLACIOLACUSTRINE GENETIC MATERIAL

Glaciolacustrine genetic material encompasses fine-grained sediment deposited in proglacial lake environments. It is designated by the landform symbol L^{G} and occurs primarily in the lower drainages of some tributary valleys of the Athabasca, North Saskatchewan and Bow River valleys. Glaciolacustrine material is texturally similar to fluviolacustrine genetic material but can be differentiated by stratification, bulk density, structural, and geomorphic environment parameters as outlined in the fluviolacustrine genetic material section.

Glaciolacustrine material is fine textured (0 – 10% sand and 30 – 50% clay) and calcareous (very strongly to extremely calcareous), hence neutral to mildly alkaline in reaction (pH 7.2 – 7.4). Noncalcareous glaciolacustrine material occurs rarely. Coarse fragments are usually absent but may range to 5% by volume.

Glaciolacustrine material commonly occurs as blankets and veneers overlying ridged, hummocky, and undulating glacial landforms of valley floor benchlands. Slopes commonly range from 0 to 10%.

EOLIAN GENETIC MATERIAL

Eolian sediment is deposited by wind. In Banff and Jasper, eolian deposits, also termed loess, are well sorted and dominated by silt (rarely <50%). Designated by the landform symbol E, Eolian Genetic Material is probably the most extensive unconsolidated mineral genetic material, but only in limited areas does it consistently exceed 30 cm in thickness. Two eolian genetic material units (Eolian material A and B) are differentiated based primarily on chemical properties (Table 16).

Eolian material A encompasses calcareous, medium textured sediment. Occurrences are restricted to valley floors, benchlands, and lower valley wall slopes in the Athabasca and Howse/North Saskatchewan River valleys at low elevations of the Montane Ecoregion. It exists

Table 16. Characteristics of eolian genetic material units.

Genetic Material Unit	Dominant Source	Usual Textural Properties		Usual Chemical Properties	
		Fine Earth	Coarse Fragments	Calcareousness	pH
Eolian material A	Braided river channels with extensive bare mineral soil	0-40% sand and 5-20% clay	0-5%	15-70% $CaCO_3$ equivalent	7.3-8.3
Eolian material B	Local unconsolidated and consolidated materials plus volcanic ash	10-50% sand and 0-25% clay	0-5%	pedogenic alteration	pedogenic alteration

as veneers and blankets overlying glacial deposits above the valley floor positions and as ridged landforms (dunes) on the Athabasca River valley floor. Slopes range from 5 to 70%. Processes modifying Eolian material A are primarily those which erode, mix, and rework surface layers. These include deflation, windthrow of trees, sheet erosion, stream channel overflow, and gullying. Eolian material A is presently aggrading with the rate of deposition decreasing upslope from the valley floors.

Eolian material B encompasses medium textured, chemically altered sediment. It occurs as thin (usually <30 cm), mineral surface veneers overlying a variety of landforms on all physiographic positions in all Ecoregions. It is most common on older, relatively stable surfaces such as morainal landscape. The deepest (15 to 30 cm) and most extensive deposits occur on stable surfaces in western Banff and southwestern Jasper. This material often comprises the upper sola of soils where pedogenic weathering is strongest, hence the altered chemical properties. Weathering of easily weatherable primary minerals is implicated in the characteristic strong pedogenic development in Eolian Material B. (Pettapiece and Pawluk 1972, Pawluk and Brewer 1975, King and Brewster 1976, and Smith 1979). Physical processes modifying Eolian material B are primarily those which erode, mix, and rework surface layers. These include sheet erosion, gully erosion, colluviation, avalanching, windthrow of trees, solifluction, and cryoturbation.

ORGANIC, CONSOLIDATED, AND ICE COMPONENTS

The organic component consists of peat deposits containing >30% organic matter by weight (>17% organic carbon) that may be as thin as 10 cm if they overlie bedrock but are otherwise >40 cm thick (C.S.S.C. 1978b). In Banff and Jasper the organic component is of limited areal extent and thinly mantles (rarely >1.2 m) glacial, proglacial, fluviolacustrine, and fluvial landforms in localities with ground water discharge and high water tables (very poor to poor drainage). It consists predominantly of moderately decomposed (mesic) fen peat designated by the landform symbol ɴ, derived primarily from sedges and brown mosses. In several localities, the fen vegetation has been succeeded by open and closed forest. Fibric and humic layers and partially decomposed wood fragments may also occur in the section. The peat is medium acid to neutral (pH 5.5-7.5). Fen surface expression is horizontal or sloping and reflects the underlying mineral deposits. Slopes range from 0 to 10%.

The consolidated component (bedrock) consists of tightly packed lithified materials, excluding materials indurated by pedogenic processes, and is harder than 3 on Mohs' hardness scale. Bedrock underlies all other materials in the parks and outcrops in all areas, most often at high elevations. Massive, resistant bedrock is more prominent in the landscape than recessive bedrock. It is the source of almost all unconsolidated mineral material in the parks.

The ice component encompasses ice and firn that forms by the compaction and recrystallization of snow. In Banff and Jasper, this includes glaciers, icefields, glacierettes, and firn. It occurs mainly in the Upper Subalpine and Alpine Ecoregions and is most extensive at higher elevations of the Main Ranges near the Continental Divide (Falconer et al. 1966). In some localities, ice is mantled by colluvial and landslide debris from adjacent steep slopes.

SOILS

FACTORS OF SOIL FORMATION

Five environmental factors are generally considered to affect soil formation. These are climate, living organisms, kind of parent material, relief, and time (or length of stability). The interaction of these soil-forming factors has resulted in many different kinds of soil throughout Banff and Jasper. The relative importance of each factor differs from place to place.

SOIL ORDERS IN BANFF AND JASPER

The soil taxonomy used in Banff and Jasper follows the Canadian System of Soil Classification (C.S.S.C. 1978b) Representatives of eight soil orders occur in the parks, including the Brunisolic, Luvisolic, Podzolic, Chernozemic, Cryosolic, Regosolic, Gleysolic, and Organic Orders.

BRUNISOLIC ORDER

The Brunisolic Order is broad in concept and, in Banff and Jasper, the most extensive relative to other orders, encompassing a wide range of characteristics. Four great groups occur in Banff and Jasper; their differentiation is based on solum reaction and A horizon characteristics.

Eutric and Melanic Brunisols have pH >5.5 at a depth of 25 cm below the top of the B horizon. These are associated with calcareous geomorphic materials. Dystric and Sombric Brunisols have pH ≤ 5.5 at a depth of 25 cm below the top of the B horizon. These are associated with non-calcareous geomorphic materials, including some with low lime content, and are less extensive than the Eutric and Melanic Brunisols.

Melanic and Sombric Brunisols are distinguished from Eutric and Dystric Brunisols by the presence of thick (10 cm or more) organo-mineral Ah horizons. Such horizons develop under non-forest vegetation where organic matter incorporation and humification are important processes.

B Horizon Characteristics of Brunisolic Soils

Brunisolic B horizons display a wide range of characteristics.

1. Brunisolic soils with weakly expressed and poorly differentiated B horizons are often associated with Regosolic soils on some geomorphically active terrain, such as steep colluvial landforms.
2. Eutric Brunisols occuring on warm, dry glacial and glaciolacustrine landforms, usually under lodgepole pine forests in the Montane and Lower Subalpine, frequently have B horizons with luvisol-like morphologies. Luvisolic soils are intimately associated. The Bm and Btj horizons of these Brunisolics display high clay contents compared to adjacent horizons, but structure and clay film development are weak and carbonate removal is incomplete.
3. Brunisolic soils with moderate or intermediate horizon development occur under intermediate mesoclimatic conditions or on stable genetic materials that do not

promote luvisolic or podzolic tendencies as a result of pedogenic weathering. Bm horizons of these Brunisolics are brownish colored and have low to moderate amounts of humus and free iron and aluminum oxides. Included are Eluviated Dystric Brunisols with duric tendencies (weak cementing) in lower B and BC horizons that are frequently developed on noncalcareous, coarse textured genetic material units, i.e. Till A, Ice Contact Stratified Drift A, and Glaciofluvial material A.

4. Brunisolic soils with strongly developed B horizons (podzolic tendencies) are associated with Podzolic soils under cool, moist Subalpine and Alpine conditions on stable landforms that include veneers of Eolian material B or Fluviolacustrine material A derived from Eolian material B (Table 8). The reddish, dark and strong brown Bm, Bfj, Bf or Bhf horizons of these Brunisolics are developed immediately above the parent material disconformity and have moderate to high, free iron and aluminum contents, weathered from the surface veneers. These B horizons also display increasing illuvial-humus content with elevation or with increasing wetness (imperfectly to poorly drained). This Brunisolic-Podzolic complex of soils is most extensive in western Banff and southwestern Jasper.
5. A variety of Brunisolic soils occurs under imperfectly to poorly drained conditions on sites affected by seepage. These are usually associated with Gleysolic and gleyed Podzolic soils. Gleyed Brunisols generally display weak mottling in a matrix background of moderate chroma within the upper 50 cm of mineral soil. A variety of climatic, geomorphic, and hydrologic factors contribute to the varying intensity of gleization across seepage affected landscape.

A Horizon Characteristics of Brunisolic Soils

The A horizons of Brunisolic soils exhibit a wide range of characteristics. They may be absent where current or recent disturbances have destroyed them or inhibited their development. On more stable slopes, eluvial (Ae) horizons are common under forest vegetation and, where >2 cm thick, are diagnostic for Eluviated subgroups within the Brunisolic Order. Organomineral Ah horizons associated with Brunisolic and other soils occur under tundra vegetation in the Alpine and Alpine-Upper Subalpine ecotone and under grassland and dry shrubland vegetation in the Subalpine. In both environments, the Ah horizon thickness is variable and largely controlled by the kind and degree of surface disturbance. The variable Ah horizon thickness results in the intimate association of Eutric with Melanic Brunisols and Dystric with Sombric Brunisols.

Upper sola of Brunisolics occurring under tundra vegetation tend to be acidic with low base saturation. Several Brunisolic subgroups are intimately associated, as are soils from the Podzolic, Regosolic, and Gleysolic Orders. Further, under heath tundra vegetation, graying A horizons with characteristics of Ah and Ae horizons (herein termed Ahe horizons) often replace or coexist with Ah horizons. Conversely, soils associated with Subalpine grasslands and dry shrublands are less variable than those under tundra vegetation. Upper sola of grassland and shrubland Brunisolics tend to have a neutral reaction with a high base saturation. Consequently, Ae and Ahe horizons giving Eluviated subgroups are absent and also, Dystric and Sombric Brunisols and Podzolics do not occur. Regosolic soils, however, are common associates. There is evidence that some of the soils occurring under grassland vegetation can also be classed as Dark Brown in the Chernozemic Order. Subalpine grasslands and dry shrublands are most common in, but not confined to, the Front Ranges and are usually associated with genetic material derived from Mesozoic strata.

LUVISOLIC ORDER

Gray Luvisols occur in association with Eutric Brunisols showing luvisolic tendencies in warm, dry, lower portions of the Lower Subalpine and throughout much of the Montane. They commonly occur on calcareous glacial and glaciolacustrine materials with rapidly to moderately well drained moisture regimes, most often under lodgepole pine forests. They are identified by eluvial Ae and illuvial Bt horizons. Structure and clay film development are more weakly expressed in Bt horizons of Banff and Jasper Luvisolics than in much of the forested areas in Alberta. Most of the Luvisolic soils have *bisequa* morphology and are classed as Brunisolic Gray Luvisols.

They have an Ae-Bm horizon sequence developed in very thin veneers of Eolian material B overlying a II Bt horizon. Orthic Gray Luvisols occur where the veneer is absent. Gleyed Brunisolic Gray Luvisols, characterized by weak mottling in middle to lower sola and C horizons, occur occasionally on seepage affected (imperfectly drained), low lime till.

PODZOLIC ORDER

Podzolic soils represent the most strongly developed soils in Banff and Jasper. They are associated with Eutric/Melanic or Dystric/Sombric Brunisols under cool, moist Subalpine and Alpine conditions on stable landforms (usually morainal) that include veneers of Eolian material B or Fluviolacustrine material A derived from Eolian material B.

The Brunisolic-Podzolic complex of soils is most common in western Banff and southwestern Jasper. Reddish to dark brown podzolic B horizons (C.S.S.C. 1978b) are diagnostic of Podzolic soils. These develop immediately above the parent material disconformity and contain high amounts (>0.6%) of free iron and aluminum weathered from the iron and aluminum containing minerals within the surfical veneers. Orthic Humo-Ferric Podzols, with podzolic Bf horizons, occur at moderate elevations under well to moderately well drained conditions with Engelmann spruce-subalpine fir and subalpine larch forests. However, illuvial humus content in the podzolic B horizons tends to increase with elevation. Consequently, Orthic Ferro-Humic Podzols, with podzolic Bhf horizons, are common under heath tundra vegetation in the Alpine and Alpine-Upper Subalpine ecotone. Podzolic soils with podzolic Bf, Bhf, or Bh horizons also occur under imperfectly to poorly drained conditions in the Subalpine and Alpine Ecoregions on landforms (usually morainal) that include the Fluviolacustrine material A veneers.

CHERNOZEMIC ORDER

Steeply sloping, southerly-facing Subalpine grasslands and dry shrublands are dominated by Regosolic and Brunisolic soils with organo-mineral Ah surface horizons. There is some new evidence, based on soil temperature data from our instrumented Mt. White grassland site in Banff, that some of the Humic Regosols and Melanic Brunisols (soils with $\geq$10 cm of Ah horizon), may, in fact, be classed as Chernozemic. Morphological and chemical data support classification in the Dark Brown Great Group of the Chernozemic Order. Chernozemic soils are not reflected in the Banff-Jasper Ecological Land Classification map legend because the temperature data are tentative and these soils are of limited areal extent.

CRYOSOLIC ORDER

Cryosolic soils represent the coldest soils found in Banff and Jasper. They have permafrost within 1 m and often within 50 cm of the ground surface. Cryosolic soils dominate many steep (30-70%), northerly-facing, forested (Engelmann spruce-subalpine fir) slopes in the Upper Subalpine in the Front Ranges subprovince north of Banff townsite. They are confined primarily to morainal landforms consisting of medium textured, variably calcareous till derived from Mesozoic strata.

Regosolic Static Cryosols are most abundant. Their genesis is commonly influenced by solifluction which disrupts horizon development and mixes geomorphic material in the thaw zone. Orthic Static Cryosols and, occasionally, Brunisolic Static Cryosols occur on sites where the solifluction process is inconsequential. Cryosolics often have thick (10-40 cm) organic layers (LFH horizons) mantling the mineral surface and are generally imperfectly drained except for a saturated zone at the frozen-unfrozen interface. Gleyed Eutric Brunisols and Gleyed Cumulic Regosols are frequently associated with Cryosolic soils. Achuff and Coen (1980) present data from a Brunisolic Static Cryosol site on Mt. White in Banff.

REGOSOLIC ORDER

Regosolic soils occur where active and recently active geomorphic processes of sufficient frequency and intensity inhibit pedogenic horizonation other than Ah horizon formation. They occur in all Ecoregions, on a variety of calcareous and noncalcareous geomorphic materials, on a variety of slopes, and under several different kinds of vegetation. Processes that modify landform surfaces and contribute to Regosolic soil maintenance are avalanching, soil creep, fluvial erosion and deposition, eolian deflation and deposition, windthrow of trees, sheet erosion, gully erosion, solifluction, and cryoturbation. Landforms of recent age also have Regosolic soils. These include recent moraines, glaciofluvial floodplains, colluvial slopes, landslides, fluvial landforms, and eolian deposits.

Regosolic soils lack significant B horizons. The Regosol Great Group lacks surface Ah horizons or has Ah horizons <10 cm thick. Humic Regosols have Ah horizons ≥ 10 cm in thickness and are common on avalanched localities, grasslands, dry shrublands, and under tundra vegetation in the Alpine and Alpine–Upper Subalpine ecotone. Cumulic Subgroups of these Great Groups have buried organic and organomineral horizons and, occasionally, buried B horizons. Gleyed and Gleyed Cumulic Subgroups occur under imperfectly to poorly drained conditions and are often associated with Gleysolic and, less often, Organic soils. Under drier conditions, Regosolic soils are most often associated with Brunisolic soils.

GLEYSOLIC ORDER

Gleysolic soils occur under imperfectly to poorly drained conditions on glacial, glaciolacustrine, fluvial, and fluviolacustrine landforms throughout all Ecoregions in Banff and Jasper. They generally occupy depressional landscapes where seepage, surface water collection, and high water tables are important and occur under a variety of moist to wet (hygric to hydric) vegetation. They are most often associated with gleyed Brunisolic, gleyed Podzolic, gleyed Regosolic, and Organic soils.

Gleysolic soils are characterized by dull colors and/or strong mottling within 50 cm of the mineral surface, features indicative of intense reducing conditions. Rego Gleysols occur on sites where saturation is prolonged or geomorphic activity has inhibited pedogenic horizonation. Orthic Gleysols occur on stable sites where B horizons have developed. Thin organic layers of moderately decomposed fen peat commonly mantle Gleysolic soils, except where mineral material is actively aggrading. Some Gleysolic soils have thin Ah horizons but Humic Gleysols (Ah horizons ≥ 10 cm thick) are of minor importance.

ORGANIC ORDER

Organic soils occur most often in association with Gleysolic soils under poorly to very poorly drained conditions, primarily on glacial, fluvial, and fluviolacustrine landforms. They are characterized by accumulations of 40 cm or more of fen peat. Prolonged periods of ponding, without mineral material sedimentation, and fen vegetation promote the accumulation of peat. Organic soils also occur on slopes of up to 15% where seepage is an important factor throughout much of the year.

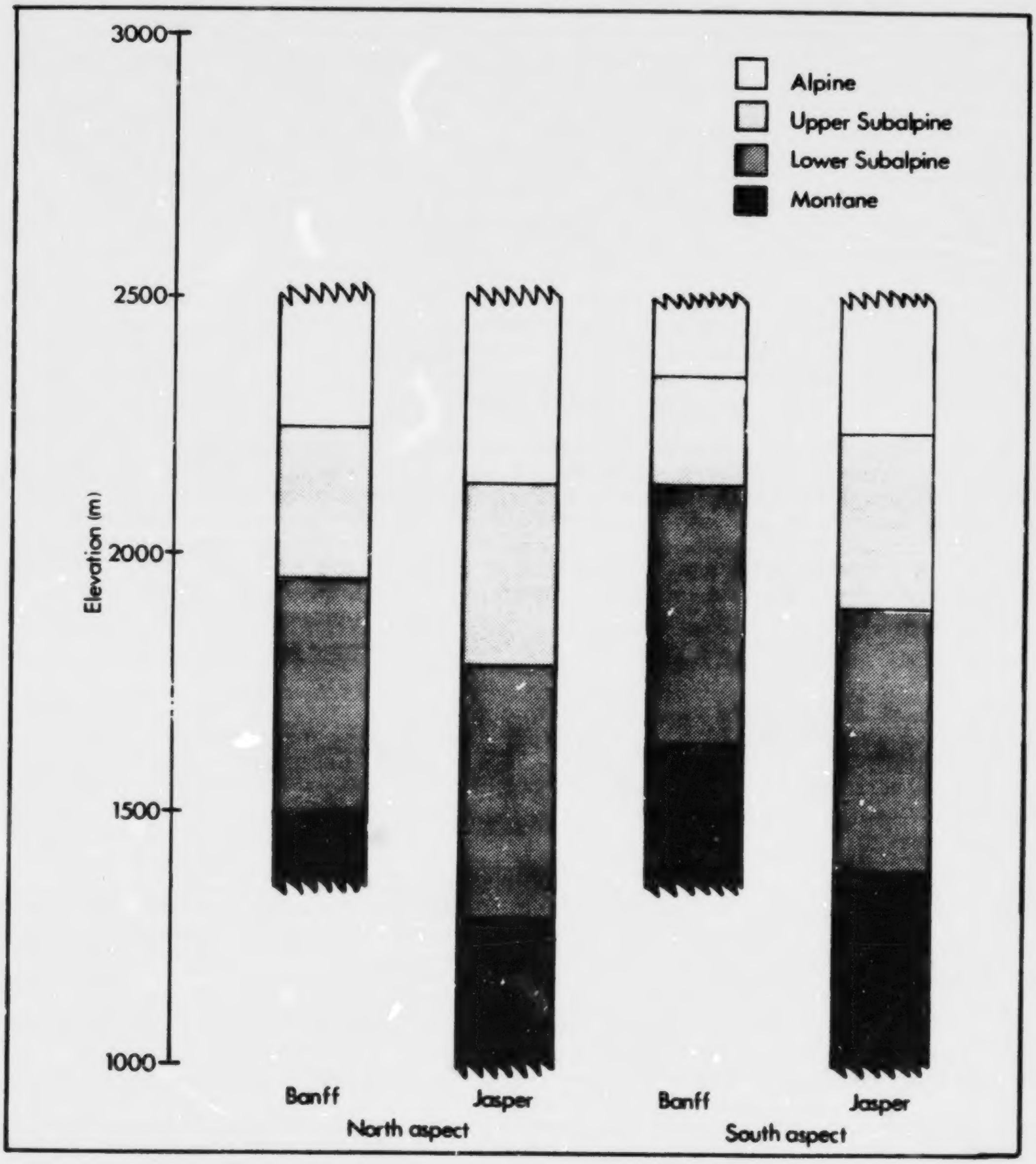
The peat is mainly moderately decomposed, hence the dominant Great Group is Mesisol. The peat accumulations rarely exceed 1.2 m in depth and the dominant Organic soils in Banff and Jasper are therefore Terric Mesisols.

VEGETATION

ECOREGIONS

Vegetation is used as the basis for definition of Ecoregions in the Ecological Land Classification. Ecoregional divisions reflect macroclimate and thus vegetational features (which primarily reflect climatic factors, rather than, for example, edaphic factors) are used to define the Ecoregions. From low to high elevation, three Ecoregions are recognized: Montane, Subalpine and Alpine (Fig. 6).

Fig. 6. Elevational ranges of Ecoregions and Ecoregion subunits in Banff and Jasper.



The Montane Ecoregion is characterized by v.t.s. dominated by Douglas fir (*Pseudotsuga menziesii*), white spruce (*Picea glauca*), and aspen poplar (*Populus tremuloides*), and by grasslands. Characteristic also is intermittent snow cover as a result of chinooks. The elevation of the Montane Ecoregion ranges from the lowest elevation in the parks (about 1350 m in Banff and 1000 m in Jasper) to about 1600 m in Banff and 1350 m in Jasper. This boundary is slightly lower on northerly aspects and slightly higher on southerly aspects.

The Subalpine Ecoregion occurs at altitudes above the Montane Ecoregion and below the unforested Alpine Ecoregion. The Subalpine Ecoregion is further divided into Lower Subalpine and Upper Subalpine portions. The predominant vegetation of the Lower Subalpine is closed coniferous forest. Mature forest is dominated by Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). Seral lodgepole pine (*Pinus contorta*) forests are common, especially at lower altitudes. The upper altitudinal boundary of the Lower Subalpine is generally about 2000 m in Banff and 1900 m in Jasper. The Upper Subalpine portion is broadly transitional between Lower Subalpine closed forest and treeless Alpine tundra. Compared to the Lower Subalpine, the Upper Subalpine is cooler and wetter, with greater snowfall, later snow melt, and a shorter growing season. Greater wind speed also appears to be a significant factor. Perhaps most characteristic are open forests and stunted tree growth forms (krummholz). Upper Subalpine closed forests typically contain some Alpine floristic elements. In southern Banff, forests containing subalpine larch (*Larix lyallii*) are characteristic of the Upper Subalpine. Lodgepole pine is generally absent and forests are usually dominated by Engelmann spruce and subalpine fir. The upper altitudinal boundary to the Alpine Ecoregion is about 2300 m in Banff and 2200 m in Jasper.

The treeless Alpine Ecoregion occurs at altitudes above the Upper Subalpine and reflects a cold, harsh climate. Alpine vegetation typically forms a complex, fine-scale mosaic in which microclimatic variations are reflected by marked changes in dominant species and v.t.s. Significant microclimatic factors include: aspect, wind exposure, time of snow melt, soil moisture, and snow depth. Dwarf shrub tundra dominated by yellow heather (*Phyllodoce glanduliflora*) and white mountain heather (*Cassiope mertensiana*) is characteristic of lower altitudes, while the highest altitude communities are usually dominated by lichens and occur on rocky shallow soil.

SUCCESSION AND CLIMAX

Succession deals with changes in vegetation through time. Primary succession occurs on sites without previous vegetation, such as newly deposited fluvial or morainal material, and may require more than a thousand years to reach a climax stage. Secondary succession occurs on sites which have been previously vegetated but have had the vegetation removed, as by fire. Secondary successions take less time than primary succession, with hundreds of years being typical.

Secondary succession following fire is the most common situation in Banff and Jasper and nearly all of the present forest has been subject to fire. For example, the Athabasca River Valley around Jasper townsite experienced major fires (>500 ha) in 24 of the years between 1665 and 1975, with most of the present forest originating after fires in 1889, 1847 and 1758 (Tande 1977). The potential complexity of successional relationships has been greatly simplified by a peak in fire frequency 100 to 120 years ago. This has resulted in the bulk of the lodgepole pine forests being in approximately the same successional stage. Earlier, preclimax stages are comparatively rare and areas of recent burn are limited, e.g. Survey Peak-Saskatchewan River Crossing and Flint's Park in Banff, lower Chaba River in Jasper.

A four stage successional sequence was used to classify v.t.s. in this report: early, intermediate, advanced and mature (climax). The early successional stage is usually heterogeneous and unstable in composition, often not referable to a v.t. and usually less than 50 years old since major disturbance or origin. The intermediate successional stage is moderately stable, more uniform in composition and dominated by species not climax for the site. Commonly, lodgepole pine dominates but Engelmann spruce and subalpine fir regeneration in the understory indicates an eventual dominance by these two species. Successionally intermediate communities are generally 50 to 100 years old, although considerable variation occurs. Advanced successional communities are generally 80 to 200 years old and are dominated by a mixture of successional and climax species. In forested v.t.s., this is most typically a mixture of lodgepole pine (successional) and Engelmann spruce or subalpine fir (climax). The duration of this stage varies but 40 to 50 years is typical. The mature (climax) stage is stable, self-perpetuating and the end point of vegetation succession. In Banff and Jasper it generally takes 100 to 200 years to reach this stage in forest communities following initiation by fire.

In the Montane Ecoregion, mature forests are generally dominated by Douglas fir and white spruce which have often developed from lodgepole pine forests. However, on some dry sites, lodgepole pine forms climax forests. On the driest Montane sites, grasslands form the mature vegetation. Fire appears to be important in maintaining these grasslands and return to a climax condition following fire may take only ten years. Mature forests in the Subalpine Ecoregion are dominated by Engelmann spruce and subalpine fir which have often succeeded lodgepole pine forests. In the Upper Subalpine where lodgepole pine is less common, spruce and fir may be the initial tree colonizers after fire and a pine stage may be absent. Succession is slower in the Upper Subalpine, often requiring more than 250 years to reach a mature stage. Succession in the treeless Alpine Ecoregion is more difficult to document than in forests where tree ages provide easily obtained evidence of stand age. Fire is infrequent in the Alpine and water erosion and cryogenic processes are the main agents of disturbance which initiate secondary succession. Succession is very slow and recovery after trampling may take hundreds of years (Willard and Marr 1971).

Succession in wetlands differs from that on uplands. The rates appear to be slower although the usual herbaceous or shrubby vegetation makes stand history determination difficult. Since most wetland v.t.s. appear to be relatively stable over a 50 to 100 year period they have been designated successionally mature in this report. Landscape changes due to peat accumulation, stream aggradation and erosion, and cryoturbation are often coincident with vegetational succession on these sites, thus confounding successional history determination.

VEGETATION TYPE DESCRIPTIONS

This section contains abbreviated descriptions of 85 v.t.s., including both environmental characteristics and characteristic species with their typical cover values. The descriptions are arranged by physiognomic class: Closed Forest (C), Open Forest (O), Shrub (S), Low Shrub-Herb (L), and Herb-Dwarf Shrub (H), and numerically within each class (C1, C2, etc). More complete descriptions are in Volume II of this report.

CLOSED FOREST VEGETATION TYPES

C1: *Pseudotsuga menziesii/Elymus innovatus*
(Douglas fir/hairy wild rye)

Environment

Ecoregion: Montane
Moisture Regime: subxeric
Soils: Eutric Brunisols, Regosolics

Slope: moderate-steep
Aspect: southerly
Landform: colluvial, morainal

Characteristic Species (% cover)

Trees	
Pseudotsuga menziesii	30-40

Shrubs

Juniperus communis	1-15	*Shepherdia canadensis*	1-5

Herbs-Dwarf Shrubs

Calamagrostis rubescens	10-35	*Fragaria virginiana*	<5
Elymus innovatus	5-20	*Achillea millefolium*	<5
Aster conspicuus	5-10	*Arctostaphylos uva-ursi*	<5

Bryoids

Hylocomium splendens	<1	*Peltigera aphthosa*	<1

Successional Status: mature
Related Vegetation Types: C5

C2: *Picea glauca/Thuidium abietinum*
(white spruce/fern moss)

Environment

Ecoregion: Montane
Moisture Regime: mesic
Soils: Cumulic Regosols, Eutric Brunisols

Slope: various
Aspect: northerly
Landform: eolian, fluvial

Characteristic Species (% cover)

Trees

Picea glauca	15-60

Shrubs

Rosa acicularis	<5	*Shepherdia canadensis*	<3

Herbs-Dwarf Shrubs

Elymus innovatus	1-10	*Pyrola secunda*	<3
Linnaea borealis	1-8		

Bryoids

Thuidium abietinum	20-95	*Hylocomium splendens*	<15

Successional Status: advanced-mature
Related Vegetation Types: C13, C26, C27, C37

C3: *Pinus contorta/Juniperus communis/Arctostaphylos uva-ursi*
(lodgepole pine/juniper/bearberry)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: subxeric-mesic
Soils: Eutric Brunisols, Regosolics

Slope: various
Aspect: southerly, westerly
Landform: morainal, colluvial, fluvial, glaciofluvial

Characteristic Species (% cover)

Trees

Pinus contorta	15-40

Shrubs

Juniperus communis	5-25	*Shepherdia canadensis*	5-15
Rosa acicularis	1-3		

Herbs-Dwarf Shrubs

Arctostaphylos uva-ursi	10-25	*Linnaea borealis*	3-8
Elymus innovatus	5-15	*Fragaria virginiana*	<1
Solidago decumbens	<1	*Hedysarum sulphurescens*	<1

Bryoids

Pleurozium schreberi	<1	*Drepanocladus uncinatus*	<1
Hylocomium splendens	<1	*Dicranum* spp.	<1

Epiphytes

Letharia vulpina

Successional Status: advanced-mature
Related Vegetation Types: C6, C9, C19

C4: *Picea glauca/Rosa acicularis/Equisetum arvense*
(white spruce/prickly rose/horsetail)

Environment

Ecoregion: Montane
Moisture Regime: subhygric-hygric
Soils: Gleysolics, Regosolics, Organics

Slope: gentle
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Trees

Picea glauca	20-55

Shrubs

Rosa acicularis	5-15	*Cornus stolonifera*	3
Alnus tenuifolia	5	*Ribes lacustre*	1

Herbs-Dwarf Shrubs

Equisetum arvense	30-50	*Equisetum pratense*	5-15
Linnaea borealis	5	*Mitella nuda*	1
Equisetum scirpoides	5	*Pyrola asarifolia*	<1

Bryoids

Hylocomium splendens	15-50

Successional Status: mature
Related Vegetation Types: C32

C5: *Picea glauca-Pseudotsuga menziesii/Hylocomium splendens*
(white spruce-Douglas fir/feathermoss)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic

Slope: various
Aspect: northerly

Soils: Eutric Brunisols, Regosolics, Gray Luvisols
Landform: fluvial, morainal

Characteristic Species (% cover)

Trees

Picea glauca	20-40	*Pseudotsuga menziesii*	20-40

Shrubs

Rosa acicularis	<1	*Shepherdia canadensis*	<1

Herbs-Dwarf Shrubs

Pyrola secunda	<1	*Linnaea borealis*	<5
Aster conspicuus	<5	*Cornus canadensis*	<5
Elymus innovatus	<3		

Bryoids

Hylocomium splendens	30-75	*Peltigera aphthosa*	3-5
Pleurozium schreberi	<1	*Ptilium crista-castrensis*	<1

Epiphytes

Letharia vulpina	*Parmelia sulcata*

Successional Status: mature
Related Vegetation Types: C1

C6: *Pinus contorta/Shepherdia canadensis/Aster conspicuus*
(lodgepole pine/buffaloberry/showy aster)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Eutric Brunisols, Regosolics, Gray Luvisols
Slope: moderate
Aspect: southerly, westerly
Landform: morainal, fluvial, colluvial, glaciofluvial

Characteristic Species (% cover)

Trees

Pinus contorta	25-45	*Picea* spp.	<10

Shrubs

Shepherdia canadensis	15-30	*Juniperus communis*	1-5
Rosa acicularis	10-20	*Spiraea lucida*	1

Herbs-Dwarf Shrubs

Aster conspicuus	10-20	*Elymus innovatus*	10-15
Linnaea borealis	3-5	*Arctostaphylos uva-ursi*	1-3
Arnica cordifolia	1-5	*Calamagrostis rubescens*	10-20

Bryoids

Hylocomium splendens	10-30	*Pleurozium schreberi*	10-25
Peltigera aphthosa	1-3		

Epiphytes

Letharia vulpina	*Alectoria* spp.
Usnea spp.	

Successional Status: intermediate-advanced
Related Vegetation Types: C3, C9, C18, C19

C8: *Picea mariana-Pinus contorta/Salix myrtillifolia/Carex vaginata* (black spruce-lodgepole pine/willow/sedge)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: hygric
Soils: Gleysolics, Organics
Slope: level-gentle
Aspect: northerly
Landform: morainal

Characteristic Species (% cover)

Trees

Picea mariana	10-40	*Pinus contorta*	5-10

Shrubs

Salix myrtillifolia	5-10	*Ledum groenlandicum*	5-20

Herbs-Dwarf Shrubs

Carex vaginata	2-5	*Carex capillaris*	1
Arctostaphylos rubra	3	*Petasites palmatus*	<1
Equisetum arvense	<1	*Equisetum scirpoides*	<1

Bryoids

Aulacomnium palustre	5-30	*Tomenthypnum nitens*	5
Hylocomium splendens	10-50	*Pleurozium schreberi*	5-20
Peltigera aphthosa	<1		

Successional Status: advanced-mature
Related Vegetation Types: O11

C9: *Pinus contorta/Vaccinium caespitosum* (lodgepole pine/dwarf bilberry)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic-subxeric
Soils: Eutric and Dystric Brunisols, Gray Luvisols
Slope: level
Aspect: southerly
Landform: fluvial, glaciofluvial, glaciolacustrine

Characteristic Species (% cover)

Trees

Pinus contorta	25-40

Shrubs

Shepherdia canadensis	6	*Rosa acicularis*	1
Juniperus communis	1		

Herbs-Dwarf Shrubs

Vaccinium caespitosum	10-25	*Calamagrostis rubescens*	2-10
Linnaea borealis	5-10	*Arctostaphylos uva-ursi*	6
Elymus innovatus	5-10		

Bryoids

Pleurozium schreberi	10-25	*Peltigera aphthosa*	3-5

Epiphytes

Alectoria spp.		*Letharia vulpina*	

Successional Status: intermediate-advanced
Related Vegetation Types: C3, C6, C18, C19, C35

C10: *Pinus contorta/Alnus crispa/Hylocomium splendens*
(lodgepole pine/green alder/feathermoss)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols
Slope: various
Aspect: northerly
Landform: morainal

Characteristic Species (% cover)

Trees

Pinus contorta	10-55	*Picea glauca*	<20

Shrubs

Alnus crispa	10-50	*Shepherdia canadensis*	<10
Rosa acicularis	<5	*Viburnum edule*	<5
Menziesia glabella	<3		

Herbs-Dwarf Shrubs

Linnaea borealis	<10	*Cornus canadensis*	<10
Elymus innovatus	3-15	*Pyrola secunda*	<3
Pyrola asarifolia	<3	*Arnica cordifolia*	<5
Aster conspicuus	<10		

Bryoids

Hylocomium splendens	15-75	*Pleurozium schreberi*	5-45
Peltigera aphthosa	<5	*Ptilium crista-castrensis*	<10

Successional Status: intermediate
Related Vegetation Types: C6, C11, C14, C19

C11: *Pinus contorta-Picea* spp./*Hylocomium splendens*
(lodgepole pine/feathermoss)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Eutric Brunisols
Slope: gentle
Aspect: northerly
Landform: glacial

Characteristic Species (% cover)

Trees

Pinus contorta	5-65	*Picea* spp.	<30

Shrubs

Ledum groenlandicum	<10	*Shepherdia canadensis*	<5
Rosa acicularis	<2		

Herbs-Dwarf Shrubs

Linnaea borealis	<25	*Cornus canadensis*	<5
Pyrola secunda	<3	*Elymus innovatus*	<5
Arnica cordifolia	<10		

Bryoids

Hylocomium splendens	30-60	*Ptilium crista-castrensis*	5-10
Pleurozium schreberi	10-50	*Peltigera aphthosa*	5-15

Epiphytes

Cetraria pinastri	*Letharia vulpina*
Hypogymnia physodes	

Successional Status: intermediate-advanced
Related Vegetation Types: C13, C19, C20, C29

C12: *Picea engelmannii-Pinus albicaulis/Menziesia glabella*
(Engelmann spruce-whitebark pine/false azalea)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols
Slope: steep
Aspect: various
Landform: morainal, colluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	10-20	*Pinus albicaulis*	10-25
Abies lasiocarpa	5-20		

Shrubs

Menziesia glabella	20-75	*Ledum groenlandicum*	5-10
Abies lasiocarpa	3-15		

Herbs-Dwarf Shrubs

Vaccinium scoparium	5-60	*Vaccinium membranaceum*	1-5
Empetrum nigrum	5-10	*Vaccinium vitis-idaea*	<1

Bryoids

Pleurozium schreberi	20-35	*Dicranum scoparium*	5-10
Peltigera aphthosa	1-2	*Cladonia* spp.	1-5

Epiphytes

Letharia vulpina	*Parmeliopsis ambigua*
Parmeliopsis hyperopta	

Successional Status: mature
Related Vegetation Types: C14

C13: *Picea engelmannii-Abies lasiocarpa/Hylocomium splendens*
(Engelmann spruce-subalpine fir/feathermoss)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: mesic–subhygric
Soils: Eutric and Dystric Brunisols, Regosolics

Slope: various
Aspect: various
Landform: glacial, colluvial, glaciofluvial, fluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	20–55	*Abies lasiocarpa*	<15

Shrubs

Abies lasiocarpa	5–15	*Picea engelmannii*	<10

Herbs–Dwarf Shrubs

Pyrola secunda	<3	*Arnica cordifolia*	<5
Equisetum scirpoides	<5	*Linnaea borealis*	<10

Bryoids

Hylocomium splendens	30–75	*Pleurozium schreberi*	10–60
Ptilium crista-castrensis	<15	*Barbilophozia lycopodioides*	<5
Peltigera aphthosa	<10	*Cladonia ecmocyna*	<1

Epiphytes

Letharia vulpina	*Parmeliopsis ambigua*

Successional Status: mature
Related Vegetation Types: C5, C11, C14, C15, C24, C30, C31

C14: *Picea engelmannii–Abies lasiocarpa/Menziesia glabella/Vaccinium scoparium*
(Engelmann spruce–subalpine fir/false azalea)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: mesic–subhygric
Soils: Eutric and Dystric Brunisols, Humo-Ferric Podzols

Slope: various
Aspect: northerly
Landform: glacial, colluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	15–75	*Abies lasiocarpa*	5–15

Shrubs

Menziesia glabella	20–70	*Ledum groenlandicum*	<10

Herbs–Dwarf Shrubs

Vaccinium scoparium	5–40	*Vaccinium membranaceum*	5–15
Vaccinium myrtillus	5–25	*Arnica cordifolia*	<10
Linnaea borealis	3–15	*Cornus canadensis*	<5
Lycopodium annotinum	<5		

Bryoids

Pleurozium schreberi	25–60	*Hylocomium splendens*	25–60

Ptilium crista-castrensis	5-15	*Barbilophozia lycopodioides*	5-20
Peltigera aphthosa	<10		

Successional Status: mature
Related Vegetation Types: C13, C20, C21

C15: *Picea engelmannii-Abies lasiocarpa/Vaccinium scoparium*
(Engelmann spruce-subalpine fir/grouseberry)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols, Humo-Ferric Podzols
Slope: various
Aspect: southerly
Landform: morainal

Characteristic Species (% cover)

Trees

Picea engelmannii	10-40	*Abies lasiocarpa*	<25

Shrubs

Abies lasiocarpa	5-30	*Picea engelmannii*	<5

Herbs-Dwarf Shrubs

Vaccinium scoparium	15-60	*Arnica cordifolia*	<10
Epilobium angustifolium	<5	*Pedicularis bracteosa*	<10
Erigeron peregrinus	<5		

Bryoids

Pleurozium schreberi	10-30	*Dicranum scoparium*	5-25
Barbilophozia hatcheri	5-20	*Barbilophozia lycopodioides*	5-20
Peltigera aphthosa	<10		

Epiphytes

Letharia vulpina		*Alectoria* spp.	

Successional Status: mature
Related Vegetation Types: C14, C21, C23, C34, O10

C16: *Populus tremuloides/Elymus innovatus-Lathyrus ochroleucus*
(aspen/hairy wild rye-peavine)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Eutric Brunisols, Regosolics, Gray Luvisols
Slope: gentle
Aspect: southerly
Landform: fluvial, morainal

Characteristic Species (% cover)

Trees

Populus tremuloides	20-60

Shrubs

Rosa acicularis	5-10	*Shepherdia canadensis*	5-15
Juniperus communis	<1		

Herbs-Dwarf Shrubs

Elymus innovatus	15-40	*Calamagrostis rubescens*	15-40
Lathyrus ochroleucus	1-3	*Aster conspicuus*	<1
Fragaria virginiana	1-5	*Galium boreale*	<1
Vicia americana	<1	*Achillea millefolium*	<1

Successional Status: intermediate-mature
Related Vegetation Types: C22

C17: *Populus balsamifera/Shepherdia canadensis*
(balsam poplar/buffaloberry)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Regosolics
Slope: gentle
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Trees

Populus balsamifera	15-50	*Picea glauca*	<10

Shrubs

Shepherdia canadensis	10-70	*Populus balsamifera*	<10
Rosa acicularis	<5	*Cornus stolonifera*	<10

Herbs-Dwarf Shrubs

Elymus innovatus	10-30	*Fragaria virginiana*	<3
Linnaea borealis	<10	*Epilobium angustifolium*	<1
Aster ciliolatus	<5		

Successional Status: early-intermediate
Related Vegetation Types: C28

C18: *Pinus contorta/Shepherdia canadensis/Vaccinium scoparium*
(lodgepole pine/buffaloberry/grouseberry)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols, Gray Luvisols
Slope: various
Aspect: various
Landform: glacial

Characteristic Species (% cover)

Trees

Pinus contorta	25-50	*Picea* spp.	3-5

Shrubs

Shepherdia canadensis	10-30	*Juniperus communis*	1-5

Herbs-Dwarf Shrubs

Vaccinium scoparium	20-45	*Elymus innovatus*	5-25
Linnaea borealis	3-10	*Arnica cordifolia*	1-5
Cornus canadensis	1-3	*Arctostaphylos uva-ursi*	1-2

Bryoids

Pleurozium schreberi	20-40	*Hylocomium splendens*	5-15
Dicranum spp.	1-3	*Peltigera aphthosa*	2-5

Epiphytes

Letharia vulpina

Successional Status: intermediate-advanced
Related Vegetation Types: C6, C9, C15, C19

C19: *Pinus contorta/Shepherdia canadensis/Linnaea borealis*
(lodgepole pine/buffaloberry/twinflower)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols, Gray Luvisols
Slope: various
Aspect: southerly, westerly
Landform: glacial

Characteristic Species (% cover)

Trees

Pinus contorta	30-50	*Picea* spp.	1-10

Shrubs

Shepherdia canadensis	10-30	*Juniperus communis*	1-3
Rosa acicularis	<1-2		

Herbs-Dwarf Shrubs

Linnaea borealis	10-25	*Calamagrostis rubescens*	5-30
Elymus innovatus	3-15	*Arctostaphylos uva-ursi*	1-3
Arnica cordifolia	1-3		

Bryoids

Hylocomium splendens	20-40	*Pleurozium schreberi*	20-35
Peltigera aphthosa	1-3		

Epiphytes

Letharia vulpina	*Cetraria pinastri*
Alectoria spp.	

Successional Status: intermediate-advanced
Related Vegetation Types: C3, C6, C9, C18

C20: *Pinus contorta/Menziesia glabella/Vaccinium scoparium*
(lodgepole pine/false azalea/grouseberry)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols
Slope: various
Aspect: northerly, easterly
Landform: morainal, glaciofluvial

Characteristic Species (% cover)

Trees			
Pinus contorta	15-65	*Picea engelmannii*	<10
Abies lasiocarpa	<10		
Shrubs			
Menziesia glabella	10-70	*Shepherdia canadensis*	<10
Ledum groenlandicum	<10	*Rhododendron albiflorum*	<10
Herbs-Dwarf Shrubs			
Vaccinium scoparium	10-40	*Vaccinium membranaceum*	10-35
Linnaea borealis	<10	*Arnica cordifolia*	<15
Cornus canadensis	<5	*Elymus innovatus*	<5
Bryoids			
Pleurozium schreberi	25-70	*Ptilium crista-castrensis*	<10
Hylocomium splendens	10-40	*Peltigera aphthosa*	<5
Epiphytes			
Letharia vulpina			

Successional Status: intermediate
Related Vegetation Types: C14, C18

C21: *Picea engelmannii-Abies lasiocarpa/Vaccinium membranaceum/Barbilophozia lycopodioides*

(Engelmann spruce-subalpine fir/tall bilberry/liverwort)

Environment

Ecoregion: Lower-Upper Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols, Humo-Ferric Podzols
Slope: various
Aspect: various
Landform: morainal, colluvial

Characteristic Species (% cover)

Trees			
Picea engelmannii	5-35	*Abies lasiocarpa*	<20
Shrubs			
Rhododendron albiflorum	10-60	*Abies lasiocarpa*	5-20
Herbs-Dwarf Shrubs			
Vaccinium membranaceum	5-35	*Phyllodoce empetriformis*	<10
Vaccinium scoparium	<15	*Empetrum nigrum*	<10
Arnica cordifolia	<5		
Bryoids			
Pleurozium schreberi	15-50	*Barbilophozia lycopodioides*	5-40
Dicranum scoparium	<15	*Peltigera aphthosa*	<5
Cladonia ecmocyna	<5		

Epiphytes

Letharia vulpina	*Parmeliopsis ambigua*

Successional Status: mature
Related Vegetation Types: C14, C15, C24

C22: *Populus tremuloides/Elymus innovatus-Aster conspicuus*
(aspen/hairy wild rye-showy aster)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic-subxeric
Soils: Regosolics, Eutric Brunisols
Slope: steep
Aspect: southerly
Landform: colluvial, fluvial, glacial

Characteristic Species (% cover)

Trees			
Populus tremuloides	20-40		
Shrubs			
Populus tremuloides	10-20	*Shepherdia canadensis*	1-2
Rosa acicularis	3-20		
Herbs-Dwarf Shrubs			
Elymus innovatus	20-50	*Arctostaphylos uva-ursi*	10-40
Aster conspicuus	5-10	*Fragaria virginiana*	<1
Achillea millefolium	<1	*Hedysarum sulphurescens*	<1
Bryoids			
Tortula ruralis	<1		

Successional Status: intermediate
Related Vegetation Types: C16

C23: *Larix lyallii-Abies lasiocarpa/Vaccinium scoparium-Antennaria lanata*
(subalpine larch-subalpine fir/grouseberry-everlasting)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols, Humo-Ferric Podzols
Slope: various
Aspect: various
Landform: colluvial, morainal

Characteristic Species (% cover)

Trees			
Larix lyallii	10-60	*Abies lasiocarpa*	<20
Shrubs			
Abies lasiocarpa	5-20	*Larix lyallii*	5-15

Herbs-Dwarf Shrubs

Vaccinium scoparium	5-40	*Phyllodoce glanduliflora*	<25
Antennaria lanata	<10	*Erigeron peregrinus*	<5
Valeriana sitchensis	<10	*Arnica latifolia*	5-20
Cassiope mertensiana	<20		

Bryoids

Barbilophozia spp.	5-30	*Polytrichum juniperinum*	<5

Epiphytes

Letharia vulpina

Successional Status: mature
Related Vegetation Types: C15, C21, O10

C24: *Picea engelmannii-Abies lasiocarpa/Salix vestita/Cassiope tetragona*
(Engelmann spruce-subalpine fir/rock willow/white mountain heather)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: mesic-subhygric
Soils: Static Cryosols, Eutric Brunisols

Slope: moderate-steep
Aspect: northerly
Landform: morainal, colluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	10-30	*Abies lasiocarpa*	3-10

Shrubs

Salix vestita	5-30	*Abies lasiocarpa*	10-20
Picea engelmannii	1-5		

Herbs-Dwarf Shrubs

Cassiope tetragona	10-35	*Phyllodoce glanduliflora*	1-10
Equisetum scirpoides	2-15		

Bryoids

Hylocomium splendens	10-50	*Pleurozium schreberi*	5-30
Dicranum scoparium	5-10	*Drepanocladus uncinatus*	1-5
Barbilophozia lycopodioides	1-5	*Peltigera aphthosa*	1-5

Epiphytes

Letharia vulpina	*Hypogymnia austerodes*

Successional Status: mature
Related Vegetation Types: C34, O12, O14

C26: *Picea glauca/Shepherdia canadensis/Thuidium abietinum*
(white spruce/buffaloberry/fern moss)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Regosolics

Slope: various
Aspect: northerly
Landform: eolian, fluvial

Characteristic Species (% cover)

Trees			
Picea glauca	25-30		
Shrubs			
Shepherdia canadensis	10-30	*Rosa acicularis*	<5
Herbs-Dwarf Shrubs			
Elymus innovatus	5-20	*Arctostaphylos uva-ursi*	3-15
Linnaea borealis	5-20	*Carex concinna*	<3
Pyrola secunda	<3		
Bryoids			
Thuidium abietinum	50-70	*Peltigera aphthosa*	<1
Peltigera canina	<1		

Successional Status: mature
Related Vegetation Types: C2, C27, C37

C27: *Picea glauca/Rosa acicularis/Thuidium abietinum*
(white spruce/prickly rose/fern moss)

Environment

Ecoregion: Montane
Moisture Regime: mesic
Soils: Regosolics
Slope: level-moderate
Aspect: northerly
Landform: eolian, fluvial

Characteristic Species (% cover)

Trees			
Picea glauca	25-35		
Shrubs			
Rosa acicularis	10-20	*Shepherdia canadensis*	<5
Lonicera dioica	<5		
Herbs-Dwarf Shrubs			
Elymus innovatus	10-20	*Linnaea borealis*	2-12
Carex eburnea	5-10	*Geocaulon lividum*	<1
Zygadenus elegans	<1	*Smilacina stellata*	<1
Fragaria virginiana	<1		
Bryoids			
Thuidium abietinum	15-50		

Successional Status: mature
Related Vegetation Types: C2, C26, C37

C28: *Populus balsamifera/Equisetum pratense*
(balsam poplar/horsetail)

Environment

Ecoregion: Montane
Moisture Regime: hygric-subhygric
Soils: Regosolics
Slope: gentle
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Trees

Populus balsamifera	35-55	*Picea glauca*	<10

Shrubs

Rosa acicularis	2	*Viburnum edule*	<5

Herbs-Dwarf Shrubs

Equisetum pratense	<60	*Equisetum arvense*	<20
Mertensia paniculata	<15	*Rubus pubescens*	<5
Petasites palmatus	<2	*Vicia americana*	1
Galium triflorum	<1		

Bryoids

Bryum caespiticium	<1	*Brachythecium salebrosum*	<1

Successional Status: intermediate
Related Vegetation Types: C16, C17

C29: *Pinus contorta/Ledum groenlandicum*
(lodgepole pine/Labrador tea)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols, Gray Luvisols

Slope: various
Aspect: northerly
Landform: morainal, fluvial, eolian

Characteristic Species (% cover)

Trees

Pinus contorta	20-45	*Picea* spp.	>10

Shrubs

Ledum groenlandicum	10-40	*Shepherdia canadensis*	1-5
Salix glauca	1-5	*Juniperus communis*	1-3

Herbs-Dwarf Shrubs

Vaccinium scoparium	5-15	*Vaccinium vitis-idaea*	3-5
Linnaea borealis	3-5	*Elymus innovatus*	1-5
Arnica cordifolia	1-5	*Cornus canadensis*	1-5

Bryoids

Pleurozium schreberi	35-45	*Ptilium crista-castrensis*	5-15
Hylocomium splendens	20-35	*Peltigera aphthosa*	1-3

Epiphytes
Letharia vulpina

Successional Status: intermediate-advanced
Related Vegetation Types: C30

C30: *Picea engelmannii–Abies lasiocarpa/Ledum groenlandicum/Empetrum nigrum*
(Engelmann spruce–subalpine fir/Labrador tea/crowberry)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols
Slope: gentle–moderate
Aspect: northerly, easterly
Landform: eolian, morainal

Characteristic Species (% cover)

Trees

Picea engelmannii	20–40	*Abies lasiocarpa*	5–10
Pinus contorta	<5		

Shrubs

Ledum groenlandicum	10–30	*Abies lasiocarpa*	3–10
Picea engelmannii	3–5	*Salix glauca*	1–3

Herbs–Dwarf Shrubs

Empetrum nigrum	8–20	*Vaccinium vitis-idaea*	3–5
Elymus innovatus	5	*Vaccinium scoparium*	5–10
Arnica cordifolia	1–3	*Cornus canadensis*	1–3

Bryoids

Hylocomium splendens	30–50	*Ptilium crista-castrensis*	5–15
Pleurozium schreberi	15–35	*Peltigera aphthosa*	1–3

Epiphytes

Letharia vulpina	*Cetraria pinastri*

Successional Status: mature
Related Vegetation Types: C29

C31: *Picea engelmannii–Abies lasiocarpa/Elymus innovatus–Arnica cordifolia–Linnaea borealis/Hylocomium splendens*
(Engelmann spruce–subalpine fir/hairy wild rye–heartleaf arnica–twinflower/feathermoss)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: mesic
Soils: Eutric Brunisols
Slope: moderate
Aspect: various
Landform: fluvial, glacial

Characteristic Species (% cover)

Trees

Picea engelmannii	30–45	*Abies lasiocarpa*	1–5
Pinus contorta	<5		

Shrubs

Juniperus communis	<5	*Shepherdia canadensis*	<5

Herbs–Dwarf Shrubs

Elymus innovatus	5–10	*Arnica cordifolia*	5–10
Linnaea borealis	5–15	*Vaccinium scoparium*	5–15

Bryoids

Hylocomium splendens	20-50	*Pleurozium schreberi*	20-30
Peltigera aphthosa	<10		

Epiphytes

Usnea sorediifera		*Bryoria glabra*	

Successional Status: mature
Related Vegetation Types: C13, C33

C32: *Picea engelmannii/Equisetum arvense/Hylocomium splendens*
(Engelmann spruce/horsetail/feathermoss)

Environment

Ecoregion: Lower Subalpine	Slope: gentle-moderate
Moisture Regime: mesic-subhygric	Aspect: various
Soils: Regosolics, Gleysolics	Landform: fluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	20-40		

Herbs-Dwarf Shrubs

Equisetum arvense	20-50	*Arnica cordifolia*	3-5
Elymus innovatus	<5	*Linnaea borealis*	5
Mertensia paniculata	<1	*Mitella nuda*	<1

Bryoids

Hylocomium splendens	25-50	*Pleurozium schreberi*	10
Ptilium crista-castrensis	5	*Peltigera aphthosa*	3

Successional Status: mature
Related Vegetation Types: C4

C33: *Picea engelmannii/Elymus innovatus*
(Engelmann spruce/hairy wild rye)

Environment

Ecoregion: Upper Subalpine	Slope: various
Moisture Regime: mesic-subxeric	Aspect: southerly
Soils: Eutric Brunisols, Regosolics	Landform: morainal, colluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	15-50	*Pinus contorta*	<10

Shrubs

Picea engelmannii	5-15	*Shepherdia canadensis*	<5
Juniperus communis	<5		

Herbs-Dwarf Shrubs

Elymus innovatus	5-40	*Arctostaphylos uva-ursi*	<10
Linnaea borealis	1-10	*Hedysarum sulphurescens*	<10
Arnica cordifolia	2-10	*Fragaria virginiana*	<5
Zygadenus elegans	<5		

Bryoids

Hylocomium splendens	<15	*Pleurozium schreberi*	<10
Peltigera aphthosa	<10		

Epiphytes

Letharia vulpina

Successional Status: mature
Related Vegetation Types: C31

C34: *Picea engelmannii–Abies lasiocarpa/Phyllodoce glanduliflora/Hylocomium splendens* (Engelmann spruce–subalpine fir/heather/feathermoss)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols, Humo-Ferric Podzols
Slope: moderate-steep
Aspect: northerly, easterly
Landform: morainal

Characteristic Species (% cover)

Trees

Picea engelmannii	15-30	*Abies lasiocarpa*	5-25

Shrubs

Abies lasiocarpa	10-50	*Picea engelmannii*	1-5

Herbs-Dwarf Shrubs

Phyllodoce glanduliflora	10-25	*Vaccinium scoparium*	5-15
Cassiope mertensiana	5-10	*Cassiope tetragona*	3-5

Bryoids

Pleurozium schreberi	15-45	*Hylocomium splendens*	10-40
Dicranum scoparium	5-20	*Drepanocladus uncinatus*	5-10
Barbilophozia lycopodioides	1-5	*Peltigera aphthosa*	1-5
Cladonia ecmocyna	1-3		

Epiphytes

Letharia vulpina
Parmeliopsis ambigua
Parmeliopsis hyperopta

Successional Status: mature
Related Vegetation Types: C13, C15, C24, O10

C35: *Pinus contorta–(Picea engelmannii)/Empetrum nigrum /Cladonia mitis* (lodgepole pine–(Engelmann spruce)/crowberry/lichen)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: subxeric
Soils: Dystric Brunisols
Slope: level-moderate
Aspect: various
Landform: glaciofluvial, glacial

Characteristic Species (% cover)

Trees

Pinus contorta	25-35	*Picea engelmannii*	5-8

Herbs-Dwarf Shrubs

Empetrum nigrum	15-35	*Vaccinium vitis-idaea*	3
Vaccinium caespitosum	4	*Juniperus communis*	<1

Bryoids

Cladonia mitis	10-15	*Stereocaulon tomentosum*	3-5
Peltigera aphthosa	<1	*Cladonia* spp.	3-10

Epiphytes

Letharia vulpina

Successional Status: advanced-mature
Related Vegetation Types: C9

C36: *Pinus contorta-Picea glauca/Salix glauca/Elymus innovatus*
(lodgepole pine-white spruce/willow/hairy wild rye)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: mesic-subhygric
Soils: Eutric Brunisols
Slope: gentle-moderate
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Trees

Pinus contorta	10-25	*Picea glauca*	5-20

Shrubs

Salix glauca	15-30	*Betula glandulosa*	5-10
Ledum groenlandicum	5	*Shepherdia canadensis*	<5

Herbs-Dwarf Shrubs

Elymus innovatus	10-25	*Linnaea borealis*	5
Fragaria virginiana	2-3	*Epilobium angustifolium*	2-3

Bryoids

Hylocomium splendens	5-25	*Pleurozium schreberi*	10-20
Peltigera aphthosa	3-5		

Successional Status: intermediate
Related Vegetation Types: C37, O18

C37: *Picea glauca/Shepherdia canadensis/Hylocomium splendens*
(white spruce/buffaloberry/feathermoss)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: mesic
Soils: Regosolics, Eutric Brunisols
Slope: various
Aspect: northerly
Landform: fluvial, morainal

Characteristic Species (% cover)

Trees			
Picea glauca	20-50	*Pinus contorta*	<10
Shrubs			
Shepherdia canadensis	10-50	*Juniperus communis*	<10
Salix glauca	<10	*Rosa acicularis*	<10
Herbs-Dwarf Shrubs			
Elymus innovatus	1-35	*Arctostaphylos uva-ursi*	<5
Linnaea borealis	1-20	*Pyrola secunda*	<1
Fragaria virginiana	<1	*Equisetum scirpoides*	<1
Bryoids			
Hylocomium splendens	20-70	*Pleurozium schreberi*	5-15
Ptilium crista-castrensis	<5	*Peltigera aphthosa*	<5

Successional Status: mature
Related Vegetation Types: C2, C26, C27

OPEN FOREST VEGETATION TYPES

O2: *Pinus flexilis-Pseudotsuga menziesii/Juniperus* spp./*Arctostaphylos uva-ursi* (limber pine-Douglas fir juniper/bearberry)

Environment

Ecoregion: Montane
Moisture Regime: xeric-subxeric
Soils: Regosolics
Slope: moderate-steep
Aspect: southerly
Landform: glacial

Characteristic Species (% cover)

Trees			
Pinus flexilis	5-40	*Pseudotsuga menziesii*	10-15
Shrubs			
Juniperus scopulorum	15-20	*Juniperus communis*	5-10
Potentilla fruticosa	<2		
Herbs-Dwarf Shrubs			
Arctostaphylos uva-ursi	20	*Artemisia frigida*	<5
Erigeron caespitosus	<4	*Anemone patens*	<3
Oxytropis sericea	<2		

Successional Status: mature
Related Vegetation Types: O5

O3: *Picea glauca/Potentilla fruticosa/Arctostaphylos uva-ursi* (white spruce/shrubby cinquefoil/bearberry)

Environment

Ecoregion: Montane
Moisture Regime: subxeric-mesic
Soils: Regosolics

Slope: level-gentle
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Trees

Picea glauca	5-20		

Shrubs

Potentilla fruticosa	1-15	*Shepherdia canadensis*	1-10
Juniperus communis	<10		

Herbs-Dwarf Shrubs

Arctostaphylos uva-ursi	5-35	*Elymus innovatus*	1-30
Fragaria virginiana	1-3		

Bryoids

Thuidium abietinum	1-10	*Ditrichum flexicaule*	<3
Peltigera canina	<1		

Successional Status: intermediate-mature
Related Vegetation Types: O17

O4: *Picea engelmannii-Abies lasiocarpa-Pinus albicaulis-Pinus contorta*
(Engelmann spruce-subalpine fir-whitebark pine-lodgepole pine)

Environment

Ecoregion: Lower-Upper Subalpine
Moisture Regime: subxeric
Soils: Eutric and Dystric Brunisols, Regosolics

Slope: steep
Aspect: southerly
Landform: colluvial, morainal

Characteristic Species (% cover)

Trees

Picea engelmannii	<20	*Abies lasiocarpa*	<20
Pinus albicaulis	<20	*Pinus contorta*	<20

Shrubs

Juniperus communis	3-20	*Shepherdia canadensis*	<15

Herbs-Dwarf Shrubs

Elymus innovatus	3-15	*Arctostaphylos uva-ursi*	3-25
Linnaea borealis	<10	*Zygadenus elegans*	<3
Fragaria virginiana	<10		

Successional Status: intermediate-mature
Related Vegetation Types: C3, O10

O5: *Pseudotsuga menziesii/Juniperus communis/Arctostaphylos uva-ursi*
(Douglas fir/juniper/bearberry)

Environment

Ecoregion: Montane
Moisture Regime: subxeric-xeric
Soils: Regosolics, Eutric Brunisols

Slope: moderate-steep
Aspect: southerly
Landform: glacial

Characteristic Species (% cover)

Trees

Pseudotsuga menziesii	5-25	*Picea glauca*	<5

Shrubs

Juniperus communis	5-15	*Pseudotsuga menziesii*	5-25
Rosa acicularis	<2	*Spiraea lucida*	≤1

Herbs-Dwarf Shrubs

Arctostaphylos uva-ursi	5-40	*Senecio canus*	1-8
Agropyron spicatum	5-20	*Koeleria cristata*	<6
Galium boreale	≤2		

Successional Status: mature
Related Vegetation Types: C1, O2

O6: *Picea engelmannii-Abies lasiocarpa/Salix* spp./*Aulacomnium palustre*
(Engelmann spruce-subalpine fir/willow/ribbed bog moss)

Environment

Ecoregion: Lower-Upper Subalpine
Moisture Regime: hygric-hydric
Soils: Gleysolics, Organics

Slope: gentle
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	3-15	*Abies lasiocarpa*	<5

Shrubs

Salix glauca	5-20	*Salix barrattiana*	10-15
Betula glandulosa	<15	*Ledum groenlandicum*	<15
Potentilla fruticosa	1-10		

Herbs-Dwarf Shrubs

Carex vaginata	5-30	*Carex aquatilis*	10-40
Equisetum arvense	1-15	*Pedicularis bracteosa*	<3
Equisetum variegatum	<2		

Bryoids

Aulacomnium palustre	10-40	*Tomenthypnum nitens*	10-35

Successional Status: mature
Related Vegetation Types: O18, S1

O7: *Picea glauca-Picea mariana/Triglochin maritima-Carex* spp.
(spruce/arrowgrass-sedge)

Environment

Ecoregion: Montane

Slope: level-very gentle

Moisture Regime: hygric-subhydric
Soils: Gleysolics
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Trees

Picea glauca	2-4	*Picea mariana*	10-15

Shrubs

Potentilla fruticosa	3-5	*Salix* spp.	1-15
Betula pumila	<1		

Herbs-Dwarf Shrubs

Triglochin maritima	<1	*Carex* spp.	2-10
Juncus balticus	<1	*Tofieldia glutinosa*	<1

Bryoids

Tomenthypnum nitens	1-35	*Drepanocladus revolvens*	<1
Campylium stellatum	<1		

Successional Status: mature
Related Vegetation Types: O11

O9: *Picea engelmannii-Abies lasiocarpa/Valeriana sitchensis-Erigeron peregrinus*
(Engelmann spruce-subalpine fir/valerian-fleabane)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: mesic-subhygric
Soils: Eutric and Dystric Brunisols, Melanic Brunisols, Gleysolics
Slope: various
Aspect: various
Landform: morainal, fluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	5-20	*Abies lasiocarpa*	5-10

Shrubs

Abies lasiocarpa	5-10	*Picea engelmannii*	1-5

Herbs-Dwarf Shrubs

Valeriana sitchensis	5-15	*Erigeron peregrinus*	5-10
Trollius albiflorus	5-10	*Vaccinium scoparium*	5-15
Cassiope mertensiana	5-10	*Erythronium grandiflorum*	5-10
Artemisia norvegica	5-10		

Bryoids

Dicranum scoparium	5-10	*Drepanocladus uncinatus*	5-10
Aulacomnium palustre	3-10	*Peltigera aphthosa*	≤1

Successional Status: mature
Related Vegetation Types: O10, H16

O10: *Picea engelmannii–Abies lasiocarpa/Phyllodoce glanduliflora–Cassiope mertensiana* (Engelmann spruce–subalpine fir/heather)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: mesic
Soils: Eutric and Dystric Brunisols, Humo-Ferric Podzols
Slope: various
Aspect: northerly
Landform: morainal, colluvial

Characteristic Species (% cover)

Trees

Picea engelmannii	<20	*Abies lasiocarpa*	<20

Shrubs

Abies lasiocarpa	10–50	*Picea engelmannii*	5–10

Herbs–Dwarf Shrubs

Phyllodoce glanduliflora	5–50	*Phyllodoce empetriformis*	5–50
Cassiope mertensiana	10–50	*Vaccinium scoparium*	5–25
Antennaria lanata	<10	*Pedicularis bracteosa*	<5

Bryoids

Barbilophozia lycopodioides	5–50	*Dicranum scoparium*	5–25
Peltigera aphthosa	<5	*Cladonia ecmocyna*	<5
Cetraria islandica	<5		

Successional Status: mature
Related Vegetation Types: C23, C34, O9, L5

O11: *Picea* spp./*Ledum groenlandicum/Tomenthypnum nitens* (spruce/Labrador tea/brown moss)

Environment

Ecoregion: Montane–Lower Subalpine
Moisture Regime: hygric–subhygric
Soils: Gleysolics, Organics
Slope: level–very gentle
Aspect: various
Landform: glacial, glaciolacustrine

Characteristic Species (% cover)

Trees

Picea spp.	5–15		

Shrubs

Ledum groenlandicum	10–15	*Betula glandulosa*	5–15
Potentilla fruticosa	3	*Salix glauca*	3
Salix myrtillifolia	5		

Herbs–Dwarf Shrubs

Carex aquatilis	10–20	*Carex vaginata*	1–3
Equisetum arvense	5–10	*Vaccinium vitis-idaea*	1–2

Bryoids

Tomenthypnum nitens	20–25	*Aulacomnium palustre*	5–10
Sphagnum warnstorfii	3–5	*Sphagnum fuscum*	5–15

Successional Status: mature
Related Vegetation Types: O6

O12: *Picea engelmannii–Abies lasiocarpa/Salix vestita/Arctostaphylos rubra*
(Engelmann spruce–subalpine fir/rock willow/alpine bearberry)

Environment

Ecoregion: Upper Subalpine	Slope: moderate–steep
Moisture Regime: mesic–subhygric	Aspect: northerly
Soils: Eutric Brunisols, Regosolics	Landform: colluvial, fluvial, morainal

Characteristic Species (% cover)

Trees			
Picea engelmannii	<15	*Abies lasiocarpa*	<10
Shrubs			
Salix vestita	10–35	*Abies lasiocarpa*	3–15
Herbs-Dwarf Shrubs			
Arctostaphylos rubra	3–15	*Dryas octopetala*	3–10
Bryoids			
Hylocomium splendens	3–15	*Dicranum scoparium*	2–10

Successional Status: mature
Related Vegetation Types: O14, S2

O14: *Picea engelmannii–Abies lasiocarpa/Salix vestita/Pedicularis bracteosa*
(Engelmann spruce–subalpine fir/rock willow/bracted lousewort)

Environment

Ecoregion: Upper Subalpine	Slope: moderate–steep
Moisture Regime: subhygric–hygric	Aspect: northerly
Soils: Gleysolics	Landform: morainal, fluvial

Characteristic Species (% cover)

Trees			
Picea engelmannii	<20	*Abies lasiocarpa*	<10
Shrubs			
Salix vestita	5–50	*Abies lasiocarpa*	10–20
Herbs-Dwarf Shrubs			
Pedicularis bracteosa	1–5	*Polygonum viviparum*	<3
Erigeron peregrinus	1–3	*Vaccinium scoparium*	2–15
Anemone parviflora	<3		
Bryoids			
Pleurozium schreberi	5–15	*Barbilophozia* spp.	3–10
Aulacomnium palustre	10	*Peltigera aphthosa*	<5

Successional Status: mature
Related Vegetation Types: O12

O16: *Betula papyrifera/Betula occidentalis/Arctostaphylos uva-ursi*

(paper birch/bearberry)

Environment

Ecoregion: Montane
Moisture Regime: subxeric
Soils: Regosolics
Slope: moderate-steep
Aspect: southerly
Landform: eolian

Characteristic Species (% cover)

Trees

Betula papyrifera	6		

Shrubs

Betula occidentalis	9	*Juniperus communis*	3
Potentilla fruticosa			

Herbs-Dwarf Shrubs

Arctostaphylos uva-ursi	40	*Elymus innovatus*	3
Aster conspicuus	2	*Carex concinna*	2
Zygadenus elegans	1	*Anemone multifida*	1
Carex scirpoidea	1		

Successional Status: intermediate-mature
Related Vegetation Types: O17

O17: *Picea glauca/Juniperus communis/Arctostaphylos uva-ursi*

(white spruce/juniper/bearberry)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: subxeric-mesic
Soils: Eutric Brunisols, Regosolics
Slope: various
Aspect: southerly, westerly
Landform: colluvial, fluvial, morainal

Characteristic Species (% cover)

Trees

Picea glauca	10-20		

Shrubs

Juniperus communis	5-20	*Shepherdia canadensis*	3-15
Rosa acicularis	1-5		

Herbs-Dwarf Shrubs

Arctostaphylos uva-ursi	10-25	*Elymus innovatus*	5-15
Linnaea borealis	3-5		

Bryoids

Thuidium abietinum	2-5	*Ditrichum flexicaule*	<1
Tortula ruralis	<1	*Peltigera canina*	<1
Peltigera rufescens	<1		

Epiphytes

Letharia vulpina	*Parmeliopsis ambigua*
Cetraria pinastri	

Successional Status: intermediate-mature
Related Vegetation Types: O3

O18: *Picea engelmannii–Abies lasiocarpa/Salix glauca/Elymus innovatus*
(Engelmann spruce–subalpine fir/willow/hairy wild rye)

Environment

Ecoregion: Lower–Upper Subalpine
Moisture Regime: mesic
Soils: Eutric Brunisols, Regosolics

Slope: moderate–steep
Aspect: southerly, westerly
Landform: fluvial, colluvial

Characteristic Species (% cover)

Trees			
Picea engelmannii	5–20	*Abies lasiocarpa*	≤5
Shrubs			
Salix glauca	5–30	*Shepherdia canadensis*	≤2
Herbs–Dwarf Shrubs			
Elymus innovatus	10–55	*Arctostaphylos uva-ursi*	2–15
Hedysarum sulphurescens	5–25	*Hedysarum alpinum*	2–10
Bryoids			
Peltigera aphthosa	<1	*Drepanocladus uncinatus*	<1
Cladonia pyxidata	<1		

Successional Status: mature
Related Vegetation Types: C33

O19: *Picea engelmannii–Abies lasiocarpa/Dryas octopetala*
(Engelmann spruce–subalpine fir/mountain avens)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: mesic
Soils: Eutric and Melanic Brunisols

Slope: steep
Aspect: various
Landform: colluvial, morainal

Characteristic Species (% cover)

Trees			
Picea engelmannii	5–20	*Abies lasiocarpa*	5–15
Herbs–Dwarf Shrubs			
Dryas octopetala	15–45	*Salix arctica*	1–5
Carex spp.	1–5	*Arctostaphylos rubra*	1–3
Artemisia norvegica	1–2	*Arctostaphylos uva-ursi*	<5
Zygadenus elegans	1–2		
Bryoids			
Tortula ruralis	1–5	*Tortula norvegica*	<1
Thuidium abietinum	1–2	*Cetraria ericetorum*	<1
Cetraria islandica	<1		

Successional Status: mature
Related Vegetation Types: O10

SHRUB VEGETATION TYPES

S1: *Betula* spp.-*Potentilla fruticosa/Tomenthypnum nitens*
(dwarf birch-shrubby cinquefoil-willow/brown moss)

Environment

Ecoregion: Montane-Upper Subalpine
Moisture Regime: subhygric-hydric
Soils: Gleysolics, Organics
Slope: level-gentle
Aspect: various
Landform: fluvial, morainal

Characteristic Species (% cover)

Shrubs

Betula spp.	5-20	*Potentilla fruticosa*	5-25
Salix glauca	10-40		

Herbs-Dwarf Shrubs

Carex aquatilis	10-40	*Deschampsia caespitosa*	10-25
Rubus acaulis	<5	*Pedicularis groenlandica*	<3

Bryoids

Tomenthypnum nitens	15-60	*Aulacomnium palustre*	<20
Drepanocladus revolvens	10-40	*Campylium stellatum*	<20

Successional Status: mature
Related Vegetation Types: S3, S4, S9, S10, S11

S2: *Abies lasiocarpa-Salix* spp./*Valeriana sitchensis*
(subalpine fir-willow)

Environment

Ecoregion: Lower-Upper Subalpine
Moisture Regime: mesic-subhygric
Soils: Regosolics, Eutric and Dystric Brunisols
Slope: steep
Aspect: various
Landform: colluvial

Characteristic Species (% cover)

Shrubs

Abies lasiocarpa	10-70	*Salix vestita*	10-20
Salix glauca	5-30		

Herbs-Dwarf Shrubs

Valeriana sitchensis	<15	*Epilobium angustifolium*	<10
Artemisia norvegica	<20	*Pedicularis bracteosa*	<12
Thalictrum occidentale	<15		

Bryoids

Pleurozium schreberi	3-5	*Brachythecium* spp.	2-5
Barbilophozia spp.	2-5		

Successional Status: mature
Related Vegetation Types: S10, H5

S3: *Betula glandulosa–Potentilla fruticosa/Scirpus caespitosus/Drepanocladus revolvens* (dwarf birch–shrubby cinquefoil/needlerush)

Environment

Ecoregion: Lower Subalpine
Moisture Regime: subhydric–hydric
Soils: Organics, Gleysolics
Slope: nearly level
Aspect: various
Landform: glacial, glaciolacustrine, fluvial

Characteristic Species (% cover)

Shrubs

Betula glandulosa	2–15	*Potentilla fruticosa*	<1–15

Herbs–Dwarf Shrubs

Scirpus caespitosus	20–80	*Pedicularis groenlandica*	1–5
Carex aquatilis	5–15	*Eriophorum angustifolium*	<1
Anemone parviflora	<1	*Antennaria lanata*	<1

Bryoids

Drepanocladus revolvens	20–80	*Tomenthypnum nitens*	5–40
Campylium stellatum	1–30		

Successional Status: mature
Related Vegetation Types: S1

S4: *Salix* spp.–*Betula glandulosa/Erigeron peregrinus* (willow–dwarf birch/fleabane)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: hygric–mesic
Soils: Gleysolics, Regosolics, Eutric Brunisols
Slope: level–moderate
Aspect: various
Landform: fluvial, morainal

Characteristic Species (% cover)

Shrubs

Salix glauca	10–45	*Betula glandulosa*	10–50
Salix barrattiana	5–20		

Herbs–Dwarf Shrubs

Erigeron peregrinus	3–10	*Fragaria virginiana*	1–10
Artemisia norvegica	1–5	*Potentilla diversifolia*	1–3
Achillea millefolium	<1	*Phleum alpinum*	<1
Trollius albiflorus	<1	*Valeriana sitchensis*	<1

Bryoids

Aulacomnium palustre	5–30	*Drepanocladus uncinatus*	3–10
Tomenthypnum nitens	5–10	*Dicranum scoparium*	3–10
Peltigera canina	<1		

Successional Status: mature
Related Vegetation Types: S8, S10, S12

S6: *Salix scouleriana–Alnus crispa/Mertensia paniculata*
(willow–green alder/bluebell)

Environment

Ecoregion: Lower Subalpine	Slope: moderate
Moisture Regime: subhygric–hygric	Aspect: northerly
Soils: Eutric Brunisols	Landform: morainal

Characteristic Species (% cover)

Shrubs			
Salix scouleriana	10–60	*Alnus* spp.	10–80
Rosa acicularis	5–15	*Rubus strigosus*	7
Viburnum edule	3	*Lonicera involucrata*	1
Herbs–Dwarf Shrubs			
Mertensia paniculata	2	*Cornus canadensis*	5
Rubus pubescens	4	*Calamagrostis canadensis*	3
Galium triflorum	<1	*Epilobium angustifolium*	<1
Viola renifolia	<1	*Moneses uniflora*	<1

Successional Status: mature
Related Vegetation Types: none

S7: *Salix* spp./*Equisetum arvense*
(willow/horsetail)

Environment

Ecoregion: Montane–Lower Subalpine	Slope: level–gentle
Moisture Regime: hygric	Aspect: various
Soils: Gleysolics, Regosolics	Landform: fluvial

Characteristic Species (% cover)

Shrubs			
Salix glauca	25–30	*Salix bebbiana*	10–25
Salix planifolia	<25	*Salix farrae*	10–15
Herbs–Dwarf Shrubs			
Equisetum arvense	1–25	*Fragaria virginiana*	<6
Achillea millefolium	<2	*Vicia americana*	<6
Taraxacum officinale	<1		
Bryoids			
Drepanocladus spp.	2–5		

Successional Status: early–intermediate
Related Vegetation Types: S11

S8: *Salix barrattiana/Potentilla diversifolia*
(willow/cinquefoil)

Environment

Ecoregion: Upper Subalpine	Slope: gentle–moderate
Moisture Regime: subhygric–hygric	Aspect: northerly, easterly
Soils: Gleysolics, Regosolics	Landform: fluvial, morainal

Characteristic Species (% cover)

Shrubs

Salix barrattiana	20-60	*Salix glauca*	5-20

Herbs-Dwarf Shrubs

Potentilla diversifolia	1-5	*Trollius albiflorus*	3-15
Erigeron peregrinus	3-10	*Artemisia norvegica*	1-10
Polygonum viviparum	1-3	*Valeriana sitchensis*	1-2
Senecio triangularis	1-2	*Pedicularis bracteosa*	<1-2

Bryoids

Aulacomnium palustre	1-30	*Tortula norvegica*	1-5
Bryum pseudotriquetrum	<1-5	*Brachythecium* spp	<1

Successional Status: mature
Related Vegetation Types: S4, S10, S12

S9: *Betula glandulosa-Salix glauca/Kobresia myosuroides*
(dwarf birch-willow/kobresia)

Environment

Ecoregion: Lower-Upper Subalpine	Slope: level-gentle
Moisture Regime: mesic	Aspect: various
Soils: Regosolics, Gleysolics, Brunisolics	Landform: fluvial

Characteristic Species (% cover)

Shrubs

Betula glandulosa	15-50	*Salix glauca*	10-30
Potentilla fruticosa	5-20		

Herbs-Dwarf Shrubs

Kobresia myosuroides	15-50	*Achillea millefolium*	<2
Elymus innovatus	2-15	*Fragaria virginiana*	2-8

Bryoids

Tortula ruralis	<5	*Cetraria ericetorum*	<1
Cladonia pyxidata	<1	*Peltigera rufescens*	<1

Successional Status: mature
Related Vegetation Types: S1, S4, S10, S11

S10: *Salix glauca-Betula glandulosa-Potentilla fruticosa*
(willow-dwarf birch-shrubby cinquefoil)

Environment

Ecoregion: Lower-Upper Subalpine	Slope: moderate-steep
Moisture Regime: mesic-subxeric	Aspect: southerly, westerly
Soils: Brunisols, Regosolics	Landform: colluvial, fluvial, morainal

Characteristic Species (% cover)

Shrubs

Salix glauca	15-40	*Betula glandulosa*	10-35
Potentilla fruticosa	1-3	*Juniperus communis*	1-10

Herbs-Dwarf Shrubs

Arctostaphylos uva-ursi	10-20	*Epilobium angustifolium*	1-5
Elymus innovatus	10-20	*Hedysarum sulphurescens*	1-5
Fragaria virginiana	2-5		

Bryoids

Tortula ruralis	1-5	*Peltigera* spp.	<1

Successional Status: mature
Related Vegetation Types: S4, S8, S11, S12

S11: *Salix glauca/Danthonia intermedia*
(willow/timber oatgrass)

Environment

Ecoregion: Lower-Upper Subalpine
Moisture Regime: hygric-mesic
Soils: Gleysolics, Regosolics, Brunisolics
Slope: gentle
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Shrubs

Salix glauca	10-45	*Betula glandulosa*	5-15
Potentilla fruticosa	5-20		

Herbs-Dwarf Shrubs

Danthonia intermedia	10-40	*Fragaria virginiana*	5-20
Phleum alpinum	1-5	*Potentilla diversifolia*	1-3
Trisetum spicatum	1-3	*Achillea millefolium*	1-2
Valeriana sitchensis	1		

Bryoids

Tortula ruralis	2-5	*Aulacomnium palustre*	5-20
Tortula norvegica	2-15	*Polytrichum juniperinum*	3-15

Successional Status: mature
Related Vegetation Types: S1, S4, S9, S10, S12

S12: *Salix glauca/Elymus innovatus*
(willow/hairy wild rye)

Environment

Ecoregion: Lower-Upper Subalpine
Moisture Regime: mesic-subhygric
Soils: Eutric Brunisols, Regosolics
Slope: various
Aspect: southerly, westerly
Landform: fluvial, colluvial, morainal

Characteristic Species (% cover)

Shrubs

Salix glauca	30-60	*Betula glandulosa*	5-15

Herbs-Dwarf Shrubs

Elymus innovatus	20-40	*Fragaria virginiana*	1-5
Achillea millefolium	1	*Astragalus alpinus*	1-3
Delphinium glaucum	1-3	*Epilobium angustifolium*	1-3
Equisetum scirpoides	1-3	*Potentilla diversifolia*	1-5
Poa spp.	1-5		

Bryoids

Tortula ruralis	<1-5	*Tortula norvegica*	<1
Peltigera rufescens	<1	*Cladonia pyxidata*	<1
Ceratodon purpureus	<1		

Successional Status: mature
Related Vegetation Types: S4, S8, S10, S11

LOW SHRUB-HERB VEGETATION TYPES

L1: *Potentilla fruticosa/Arctostaphylos uva-ursi-Galium boreale*
(shrubby cinquefoil/bearberry-northern bedstraw)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: subxeric-xeric
Soils: Regosolics
Slope: steep
Aspect: southerly
Landform: colluvial, eolian, glacial

Characteristic Species (% cover)

Shrubs

Potentilla fruticosa	<15	*Juniperus communis*	<5

Herbs-Dwarf Shrubs

Arctostaphylos uva-ursi	10-55	*Galium boreale*	<3
Artemisia frigida	<5	*Anemone multifida*	<2
Koeleria cristata	<5	*Campanula rotundifolia*	<1
Elymus innovatus	<15	*Agropyron spicatum*	<10

Successional Status: mature
Related Vegetation Types: C3, H14

L2: *Juniperus communis-Salix glauca*
(juniper-willow)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: subxeric
Soils: Regosolics, Eutric Brunisols
Slope: steep
Aspect: southerly
Landform: colluvial

Characteristic Species (% cover)

Shrubs

Juniperus communis	10-25	*Salix glauca*	10-25
Potentilla fruticosa	1-5	*Shepherdia canadensis*	2-5
Rosa acicularis	1-2		

Herbs-Dwarf Shrubs

Arctostaphylos uva-ursi	10-25	*Fragaria virginiana*	1-3
Elymus innovatus	1-3	*Epilobium angustifolium*	1-3
Achillea millefolium	<1	*Saxifraga bronchialis*	<1
Trisetum spicatum	<1	*Zygadenus elegans*	<1
Linnaea borealis	<1		

Successional Status: mature
Related Vegetation Types: S10

L4: *Cassiope tetragona-Dryas octopetala-Salix nivalis*
(white mountain heather-mountain avens-snow willow)

Environment

Ecoregion: Alpine
Moisture Regime: mesic-subhygric
Soils: Brunisols, Regosolics
Slope: gentle-steep
Aspect: northerly
Landform: morainal, colluvial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Cassiope tetragona	10-50	*Phyllodoce glanduliflora*	<15
Dryas octopetala	10-35	*Salix nivalis*	10-35
Polygonum viviparum	<1	*Silene acaulis*	<5
Potentilla diversifolia	1	*Salix arctica*	<15

Bryoids

Dicranum scoparium	<2	*Cetraria islandica*	<5
Cetraria nivalis	<3	*Stereocaulon alpinum*	<3

Successional Status: mature
Related Vegetation Types: C23, O10, L5, H1

L5: *Phyllodoce glanduliflora-Cassiope mertensiana-Antennaria lanata*
(heather-everlasting)

Environment

Ecoregion: Alpine
Moisture Regime: mesic
Soils: Brunisolics, Humo-Ferric Podzols
Slope: various
Aspect: various
Landform: morainal, residual

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Phyllodoce glanduliflora	10-50	*Cassiope mertensiana*	10-70
Cassiope tetragona	<10	*Antennaria lanata*	2-15
Salix arctica	<15	*Sibbaldia procumbens*	<5
Erigeron peregrinus	<2	*Potentilla diversifolia*	<1
Luzula wahlenbergii	1	*Artemisia norvegica*	<5

Bryoids

Dicranum scoparium	<10	*Polytrichum juniperinum*	<3
Cladonia ecmocyna	<3	*Cetraria islandica*	<2

Successional Status: mature
Related Vegetation Types: C23, O10, L4

L6: *Juniperus horizontalis-Agropyron dasystachyum-Carex scirpoidea*
(creeping juniper-northern wheatgrass-sedge)

Environment

Ecoregion: Montane
Moisture Regime: subxeric
Soils: Regosolics
Slope: various
Aspect: southerly
Landform: eolian

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Juniperus horizontalis	20-30	*Agropyron dasystachyum*	5-10
Carex scirpoidea	5-30	*Potentilla fruticosa*	<5
Hedysarum mackenzii	<5	*Arctostaphylos uva-ursi*	<5
Koeleria cristata	<5	*Senecio cymbalarioides*	<1
Carex richardsonii	<1		

Successional Status: mature
Related Vegetation Types: H6, H7

L7: *Salix arctica-Potentilla diversifolia*
(arctic willow-cinquefoil)

Environment

Ecoregion: Upper Subalpine-Alpine
Moisture Regime: mesic-subhygric
Soils: Regosolics, Gleysolics, Brunisolics
Slope: various
Aspect: various
Landform: morainal, fluvial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Salix arctica	10-35	*Potentilla diversifolia*	1-3
Antennaria lanata	5-20	*Phyllodoce glanduliflora*	1-5
Salix nivalis	1-5	*Castilleja occidentalis*	1-3
Erigeron peregrinus	<1	*Poa alpina*	<1
Polygonum viviparum	<1	*Sibbaldia procumbens*	<1
Artemisia norvegica	<1		

Bryoids

Cladonia pyxidata	<1	*Cetraria ericetorum*	<1
Cetraria cucullata	<1		

Successional Status: mature
Related Vegetation Types: H2, H16

HERB-DWARF SHRUB VEGETATION TYPES

H1: *Dryas octopetala-Salix nivalis-Silene acaulis*
(mountain avens-snow willow-moss campion)

Environment

Ecoregion: Alpine
Moisture Regime: mesic-subxeric
Soils: Regosolics, Brunisolics
Slope: various
Aspect: southerly, westerly
Landform: morainal, colluvial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Dryas octopetala	20-50	*Salix nivalis*	1-10
Silene acaulis	1-3	*Oxytropis podocarpa*	<3
Polygonum viviparum	1-2	*Selaginella densa*	<1
Poa alpina	<1	*Potentilla diversifolia*	<1
Salix arctica	<1	*Castilleja occidentalis*	<1
Carex nardina	<1	*Saxifraga oppositifolia*	<1

Bryoids

Cetraria nivalis	<1	*Cetraria cucullata*	<1

Successional Status: mature
Related Vegetation Types: L4, L5, L7, H2, H4

H2: *Carex nigricans-Antennaria lanata*
(black alpine sedge-everlasting)

Environment

Ecoregion: Alpine
Moisture Regime: mesic-subhygric
Soils: Dystric and Sombric Brunisols, Humo-Ferric Podzols

Slope: various
Aspect: various
Landform: morainal, residual

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Carex nigricans	10-90	*Antennaria lanata*	5-35
Luzula wahlenbergii	<5	*Sibbaldia procumbens*	<5
Veronica alpina	<3	*Juncus drummondii*	<5
Poa alpina	<10	*Ranunculus eschscholtzii*	<5
Salix arctica	<12	*Phyllodoce glanduliflora*	<10

Bryoids

Pogonatum alpinum	2-20	*Tortula norvegica*	<2
Cladonia ecmocyna	<5		

Successional Status: mature
Related Vegetation Types: L4, L5, L7, H1

H3: *Carex scirpoidea-Saxifraga aizoides*
(sedge-saxifrage)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: hygric
Soils: Gleysolics

Slope: level
Aspect: various
Landform: fluvial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Carex scirpoidea	1-5	*Saxifraga aizoides*	1-5
Anemone parviflora	1-3	*Tofieldia pusilla*	<3
Polygonum viviparum	<1	*Equisetum variegatum*	<1
Castilleja occidentalis	<1	*Dryas integrifolia*	<1
Arctostaphylos rubra	<1	*Pinguicula vulgaris*	<1
Potentilla fruticosa	<1	*Saxifraga* sp.	<1

Successional Status: early-intermediate
Related Vegetation Types: S7

H4: *Dryas octopetala-Kobresia myosuroides-Arctostaphylos uva-ursi*
(mountain avens-kobresia-bearberry)

Environment

Ecoregion: Upper Subalpine-Alpine
Moisture Regime: subxeric-mesic
Soils: Melanic and Eutric Brunisols, Humic Regosolics
Slope: moderate-steep
Aspect: southerly
Landform: morainal, colluvial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Dryas octopetala	10-35	*Arctostaphylos uva-ursi*	5-30
Kobresia myosuroides	15-40	*Polygonum viviparum*	<5
Oxytropis podocarpa	<15	*Androsace chamaejasme*	<3
Silene acaulis	<2		

Bryoids

Cetraria nivalis	<10	*Cetraria cucullata*	<10

Successional Status: mature
Related Vegetation Types: H1, H5, H14

H5: *Elymus innovatus-Fragaria virginiana-Epilobium angustifolium*
(hairy wild rye-wild strawberry-fireweed)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: mesic
Soils: Melanic Brunisols, Humic Regosols
Slope: steep
Aspect: southerly
Landform: colluvial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Elymus innovatus	15-55	*Fragaria virginiana*	1-10
Myosotis alpestris	<10	*Epilobium angustifolium*	<10
Zygadenus elegans	<8	*Achillea millefolium*	<5
Salix spp.	<5	*Rosa acicularis*	<5

Successional Status: mature
Related Vegetation Types: H6, H7, H14, H16, S2

H6: *Koeleria cristata-Artemisia frigida-Linum lewisii*
(junegrass-pasture sage-wild blue flax)

Environment

Ecoregion: Montane
Moisture Regime: subxeric-xeric
Soils: Regosolics, Eutric Brunisols
Slope: level-moderate
Aspect: southerly
Landform: fluvial, glaciofluvial, eolian

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Koeleria cristata	15-30	*Artemisia frigida*	1-20
Linum lewisii	1-10	*Antennaria nitida*	1-10
Galium boreale	<5	*Senecio cymbalarioides*	1-5
Gaillardia aristata	<5		

Bryoids

Tortula ruralis	<3

Successional Status: mature
Related Vegetation Types: H7, H13, H14

H7: *Agropyron dasystachyum-Artemisia frigida*
(wheatgrass-pasture sage)

Environment

Ecoregion: Montane
Moisture Regime: xeric
Soils: Eutric Brunisols, Regosolics
Slope: steep
Aspect: southerly
Landform: colluvial, glacial, fluvial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Agropyron dasystachyum	5-50	*Artemisia frigida*	1-10
Koeleria cristata	2-10	*Achillea millefolium*	<5

Successional Status: mature
Related Vegetation Types: H6, H13, H14

H8: *Dryas drummondii-Epilobium latifolium*
(yellow dryad-willow herb)

Environment

Ecoregion: Montane-Lower Subalpine
Moisture Regime: subxeric-subhygric
Soils: Regosolics
Slope: gentle
Aspect: various
Landform: fluvial, glaciofluvial, morainal

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Dryas drummondii	25-80	*Shepherdia canadensis*	<10
Salix brachycarpa	<15	*Arctostaphylos uva-ursi*	<5
Epilobium latifolium	<2		

Bryoids

Drepanocladus uncinatus	<3	*Tortula norvegica*	<10

Successional Status: early
Related Vegetation Types: O3, S7, H3

H9: *Caltha leptosepala–Trollius albiflorus*
(mountain marigold–globeflower)

Environment

Ecoregion: Upper Subalpine–Alpine
Moisture Regime: subhygric–hygric
Soils: Gleysolics
Slope: gentle–moderate
Aspect: northerly, easterly
Landform: fluvial, morainal

Characteristic Species (% cover)

Herbs–Dwarf Shrubs

Caltha leptosepala	10–25	*Trollius albiflorus*	15–40
Carex nigricans	5–20	*Salix arctica*	5–10
Senecio triangularis	<10	*Erigeron peregrinus*	<10
Antennaria lanata	<10	*Pedicularis bracteosa*	<5
Polygonum viviparum	<5	*Valeriana sitchensis*	<5

Bryoids

Aulacomnium palustre	10–50	*Campylium stellatum*	<10

Successional Status: mature
Related Vegetation Types: H2, H10, H16

H10: *Eriophorum angustifolium–Drepanocladus* spp.
(cottongrass/moss)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: hydric
Soils: Gleysolics, Organics
Slope: gentle
Aspect: various
Landform: fluvial, morainal

Characteristic Species (% cover)

Herbs–Dwarf Shrubs

Eriophorum angustifolium	20–60	*Caltha leptosepala*	variable
Carex nigricans	var.	*Pedicularis groenlandica*	variable
Scirpus caespitosus	var.		

Bryoids

Drepanocladus exannulatus	70–80	*Drepanocladus revolvens*	variable
Calliergon sarmentosum	var.	*Paludella squarrosa*	variable

Successional Status: mature
Related Vegetation Types: H9, H16

H11: *Carex aquatilis–Carex rostrata*
(water sedge–beaked sedge)

Environment

Ecoregion: Montane–Upper Subalpine
Moisture Regime: hydric–subhydric
Soils: Organics, Gleysolics
Slope: level
Aspect: level
Landform: fluvial, morainal

Characteristic Species (% cover)

Herbs–Dwarf Shrubs

Carex aquatilis	15–70	*Carex rostrata*	10–60
Equisetum fluviatile	20–55	*Utricularia intermedia*	<4
Lemna minor	<1		

Bryoids

Drepanocladus revolvens	10–55	*Tomenthypnum nitens*	<35
Campylium stellatum	<15	*Bryum pseudotriquetrum*	<10

Successional Status: mature
Related Vegetation Types: S1, S7

H12: Saxicolous lichen

Environment

Ecoregion: Alpine
Moisture Regime: subxeric–xeric
Soils: Regosolics, nonsoil
Slope: various
Aspect: various
Landform: colluvial, bedrock

Characteristic Species (% cover)

Herbs–Dwarf Shrubs

Silene acaulis	<1	*Saxifraga oppositifolia*	<1
Selaginella densa	<1	*Oxytropis podocarpa*	<1
Draba incerta	<1	*Salix nivalis*	<1

Bryoids

Xanthoria elegans	<1	*Rhizocarpon geographicum*	<1
Cetraria tilesii	<1	*Sporastatia testudinea*	<1
Cetraria nivalis	<1	*Acarospora chlorophana*	<1
Cladonia pyxidata	<1	*Dactylina ramulosa*	<1

Successional Status: mature
Related Vegetation Types: H1

H13: *Stipa richardsonii–Koeleria cristata–Antennaria nitida*
(Richardson needlegrass–junegrass–everlasting)

Environment

Ecoregion: Montane
Moisture Regime: subxeric–xeric
Soils: Regosolics, Eutric Brunisols
Slope: level–gentle
Aspect: southerly
Landform: glaciofluvial, fluvial, colluvial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Stipa richardsonii	5-20	*Koeleria cristata*	2-10
Antennaria nitida	<8	*Anemone multifida*	<5
Selaginella densa	5	*Penstemon confertus*	<3
Galium boreale	<2	*Festuca scabrella*	<1

Successional Status: mature
Related Vegetation Types: H6, H7, H14

H14: *Elymus innovatus-Koeleria cristata-Arctostaphylos uva-ursi*
(hairy wild rye-junegrass-bearberry)

Environment

Ecoregion: Lower-Upper Subalpine
Moisture Regime: subxeric
Soils: Melanic and Eutric Brunisols

Slope: steep
Aspect: southerly
Landform: colluvial, morainal

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Elymus innovatus	5-50	*Hedysarum sulphurescens*	5-15
Koeleria cristata	5-35	*Arctostaphylos uva-ursi*	5-20
Bromus pumpellianus	1-10	*Achillea millefolium*	1-2
Fragaria virginiana	<10	*Anemone multifida*	<10
Cerastium arvense	<10	*Oxytropis splendens*	1
Myosotis alpestris	1-5	*Campanula rotundifolia*	<3
Antennaria nitida	1-2	*Poa* spp.	

Bryoids

Tortula ruralis	<5

Successional Status: mature
Related Vegetation Types: H4, H5, H6, H7, H13

H15: *Dryas integrifolia-Carex rupestris*
(mountain avens-curly sedge)

Environment

Ecoregion: Upper Subalpine
Moisture Regime: subhygric
Soils: Eutric Brunisols, Regosolics

Slope: steep
Aspect: easterly
Landform: morainal

Characteristic Species (% cover)

Herbs-Dwarf Shrubs

Dryas integrifolia	10	*Carex rupestris*	20
Carex scirpoidea	3	*Carex albo-nigra*	3
Cassiope tetragona	3	*Ledum groenlandicum*	2
Arctostaphylos rubra	1		

Bryoids

Cetraria sp.	<1

Successional Status: mature
Related Vegetation Types: H1

H16: *Erigeron peregrinus-Valeriana sitchensis*
(fleabane-valerian)

Environment

Ecoregion: Upper Subalpine	Slope: various
Moisture Regime: subhygric-mesic	Aspect: various
Soils: Dystric Brunisols, Gleysolics, Regosolics	Landform: fluvial, morainal

Characteristic Species (% cover)

Herbs-Dwarf Shrubs			
Erigeron peregrinus	5-20	*Valeriana sitchensis*	5-20
Trollius albiflorus	5-20	*Anemone occidentalis*	5-15
Senecio triangularis	1-10	*Antennaria lanata*	1-5
Artemisia norvegica	1-5	*Pedicularis bracteosa*	<1-3
Salix arctica	1-5	*Potentilla diversifolia*	<1-2
Carex nigricans	<1	*Sibbaldia procumbens*	<1
Phleum alpinum	<1		
Bryoids			
Tortula ruralis	<15	*Pseudoleskea radicosa*	<15

Successional Status: mature
Related Vegetation Types: L7, H2, H9

H19: *Agropyron spicatum-Elymus innovatus-Aster conspicuus*
(bluebunch wheatgrass-hairy wild rye-showy aster)

Environment

Ecoregion: Montane-Lower Subalpine	Slope: steep
Moisture Regime: xeric	Aspect: southerly
Soils: Regosolics	Landform: colluvial, glacial

Characteristic Species (% cover)

Herbs-Dwarf Shrubs			
Agropyron spicatum	15-30	*Elymus innovatus*	10-30
Koeleria cristata	3-10	*Aster conspicuus*	3-5
Oxytropis splendens	<8	*Antennaria nitida*	<2
Cerastium arvense	<2		

Successional Status: mature
Related Vegetation Types: H4, H5, H6, H7, H13, H14

H20: *Saxifraga bronchialis-Elymus innovatus*
(spotted saxifrage-hairy wild rye)

Environment

Ecoregion: Upper Subalpine	Slope: steep
Moisture Regime: subxeric-xeric	Aspect: southerly
Soils: Regosolics	Landform: colluvial

Characteristic Species (% cover)

(cover is variable for all species, with total cover usually <50%)

Herbs--Dwarf Shrubs

Saxifraga bronchialis
Potentilla nivea
Festuca saximontana
Elymus innovatus
Achillea millefolium
Zygadenus elegans

Bryoids

Tortula ruralis

Successional Status: mature
Related Vegetation Types: H12

KEY TO VEGETATION TYPES

USE OF THE KEY

The term *dominant* (species with the highest % cover) is used in the key, but *abundant* can usually be substituted. Occasionally, species other than those in the key leads may be dominant. In such cases, use the species in the key leads which is most abundant. For example, in a *Pinus contorta/Shepherdia canadensis* closed forest (lead 8) *Elymus innovatus* (35%) may be dominant with *Linnaea borealis* (5%), *Aster conspicuus* (2%) and *Vaccinium scoparium* (25%). *Elymus innovatus* is dominant but not in the key leads. Therefore, use the most abundant species which is in the leads, which is *Vaccinium scoparium* and the stand keys to C18.

The following general cover value terms are used but should not be rigidly interpreted: sparse <15%, moderate 15–50%, and dense >50%. Often the cover of a species relative to other species in the stand is a better guide to its significance than the absolute cover values. Polychotomous leads have been used to save space and simplify the key. Alternative leads are grouped to minimize confusion.

Not all stands will key to a v.t.; intermediates occur and heterogeneous stands may be virtually unclassifiable, although their affinities may be apparent. The descriptions contain additional information and comments on related v.t.s which will help better place the stand in question. The key is only an aid to classification. Always consult the v.t. description to validate the determination.

KEY TO PHYSIOGNOMIC GROUPS

1a. Vegetation with trees ≥ 5m tall and tree cover >5 % 2
1b. Vegetation without trees ≥ 5m tall or tree cover <5 % 3
    2a. Distance between tree crowns < 2X crown width, total tree cover usually >20% (some Open Forest stands with 15–20% tree cover may key here) .... Closed Forest(C), I
    2b. Distance between tree crowns 2–5X crown width, total tree cover usually ≤ 20%, (some sparse Closed Forest stands with <20% cover may key here) .... Open Forest(O), II
3a. Vegetation dominated by shrubs ≥ 0.5–5m tall .... Shrub(S), III
3b. Vegetation dominated by plants ≤ 0.5m tall 4
    4a. Vegetation dominated by low shrubs (0.1–0.5m tall) and herbs .... Low Shrub(L), IV
    4b. Vegetation dominated by dwarf shrubs (<0.1m tall) or herbs .... Herb–Dwarf Shrub(H), V

I. KEY TO CLOSED FOREST VEGETATION TYPES

1a.	Dominant trees broad-leaved	2
1b.	Dominant trees needle-leaved	5
2a.	Dominant tree *Populus tremuloides*	3
2b.	Dominant tree *Populus balsamifera*	4
3a.	*Lathyrus ochroleucus* and *Galium boreale* > *Aster conspicuus*, landform fluvial	C16
3b.	*Aster conspicuus* > *Lathyrus ochroleucus* and *Galium boreale*, landform colluvial	C22
4a.	*Shepherdia canadensis* and *Elymus innovatus* dominant, site mesic	C17
4b.	*Shepherdia canadensis* not dominant, *Equisetum* spp. dominant herbs, site hygric to subhygric	C28
5a.	Dominant tree *Larix lyallii*, occasionally codominant with *Abies lasiocarpa* (some stands may have open canopy)	C23
5b.	Dominant tree *Pseudotsuga menziesii* (if codominant with *Picea glauca* see C5)	C1
5c.	Dominant tree *Picea mariana*, *Pinus contorta* may be codominant	C8
5d.	Dominant trees *Picea engelmannii* and *Pinus albicaulis*	C12
5e.	Dominant tree *Pinus contorta*, *Picea* spp. may be codominant	6
5f.	Dominant tree *Picea* spp., *Abies lasiocarpa* may be codominant	11
6a.	Dominant shrub *Menziesia glabella*	C20
6b.	Dominant shrub *Alnus crispa*	C10
6c.	Dominant shrub *Salix glauca*	C36
6d.	Dominant shrub *Ledum groenlandicum*	C29
6e.	Dominant shrub *Juniperus communis*	C3
6f.	Dominant shrub *Shepherdia canadensis*	7
6g.	Shrub layer sparse, may have well developed dwarf shrub layer	9
7a.	*Aster conspicuus* 10–20%, site mesic	C6
7b.	*Aster conspicuus* <10%, site various	8
8a.	Dominant dwarf shrub *Vaccinium scoparium*	C18
8b.	Dominant dwarf shrub *Linnaea borealis*	C19
9a.	Herb-dwarf shrub layer sparse, bryoid layer well developed with *Hylocomium splendens* and *Pleurozium schreberi* dominant, site mesic	C11
9b.	Herb-dwarf shrub layer moderate to dense, sites mesic or subxeric	10
10a.	*Vaccinium caespitosum* dominant dwarf shrub, *Cladonia* spp <25%, site mesic to subxeric	C9
10b.	*Empetrum nigrum* dominant dwarf shrub, *Cladonia* spp. >25%, site subxeric	C35
10c.	*Juniperus communis* and *Arctostaphylos uva-ursi* dominant dwarf shrubs, site subxeric	C3
11a.	Herb-dwarf shrub layer dominated by *Equisetum* spp.	12
11b.	Herb-dwarf shrub layer not dominated by *Equisetum* spp.	13
12a.	Shrub layer dense, dominated by *Rosa acicularis*, *Arnica cordifolia*, *Elymus innovatus* and *Mertensia paniculata* usually absent Montane, site subhygric to hygric, *Picea* usually *Picea glauca*	C4
12b.	Shrub layer sparse, *Rosa acicularis* usually absent, *Arnica cordifolia*, *Elymus innovatus* and *Mertensia paniculata* usually present, Lower Subalpine, site mesic to subhygric, *Picea* usually *Picea engelmannii*	C32
13a.	Shrub layer dominated by *Rosa acicularis*, Jasper only	C27
13b.	Shrub layer dominated by *Menziesia glabella*	C14

13c	Shrub layer dominated by *Vaccinium membranaceum* (or *Rhododendron albiflorum*)	C21
13d	Shrub layer dominated by *Salix vestita*, *Cassiope tetragona* present	C24
13e	Shrub layer dominated by *Ledum groenlandicum*, *Empetrum nigrum* usually present	C30
13f	Shrub layer dominated by *Shepherdia canadensis*	14
13g	Shrub layer sparse	15
14a	*Thuidium abietinum* dominant bryophyte	C26
14b	*Hylocomium splendens* dominant bryophyte	C37
15a	*Thuidium abietinum* dominant bryophyte, Jasper only	C2
15b	*Thuidium abietinum* not dominant bryophyte, both Banff and Jasper	16
16a	*Vaccinium membranaceum* dominant dwarf shrub, *Barbilophozia lycopodioides* dominant bryophyte	C21
16b	*Vaccinium membranaceum* not dominant dwarf shrub, *Hylocomium splendens* (occasionally *Pleurozium schreberi* or *Dicranum* spp.) dominant bryophyte	17
17a	Herb-dwarf shrub layer cover <15%, *Vaccinium scoparium* usually absent, Lower Subalpine	C13
17b	Herb-dwarf shrub layer cover >15%, *Vaccinium scoparium* usually present, Lower or Upper Subalpine	18
18a	Herb-dwarf shrub layer dominated by *Phyllodoce glanduliflora* (or sometimes *Phyllodoce empetriformis*), herb cover low, Upper Subalpine	C34
18b	Herb-dwarf shrub layer dominated by *Elymus innovatus*, *Arnica cordifolia* and *Linnaea borealis*, herb cover high, Lower Subalpine	C31
18c	Herb-dwarf shrub layer dominated by *Vaccinium scoparium*, herb cover variable, Upper Subalpine	C15

II. KEY TO OPEN FOREST TYPES

1a	Tree layer dominated by *Pinus flexilis*, often with *Pseudotsuga menziesii*	O2
1b	Tree layer dominated by *Pseudotsuga menziesii*	O5
1c	Tree layer dominated by mixture of *Picea* spp., *Abies lasiocarpa*, *Pinus albicaulis* and *Pinus contorta*; *Pseudotsuga menziesii* may be present at lower altitudes; usually on steep, colluvial, subxeric site (some open C35 may key here)	O4
1d	Tree layer dominated by *Betula* spp.	O16
1e	Tree layer dominated by *Picea glauca* and *Picea mariana*	O7
1f	Tree layer dominated by *Pinus contorta* with prominent *Juniperus communis* and *Arctostaphylos uva-ursi* in understory	open variant of C3
1g	Tree layer dominated by *Picea glauca* or *Picea engelmannii*, *Abies lasiocarpa* may be codominant	2
2a	*Ledum groenlandicum* dominant shrub	O11
2b	*Salix* spp. dominant shrub	3
2c	*Potentilla fruticosa* dominant shrub	O3
2d	*Juniperus communis* dominant shrub	O17
2e	Shrub layer sparse or dominated by tree regeneration	6
3a	*Salix vestita* dominant shrub	4
3b	Dominant shrub *Salix* spp. other than *Salix vestita*	5
4a	*Arctostaphylos rubra* dominant in herb-dwarf shrub layer	O12
4b	*Pedicularis bracteosa* dominant in herb-dwarf shrub layer	O14
5a	*Elymus innovatus* dominant herb, site mesic	O18
5b	*Carex* spp. dominant herb, site hygric to hydric	O6

6a. Herb-dwarf shrub layer dominated by *Dryas octopetala* O19
6b. Herb-dwarf shrub layer dominated by *Phyllodoce glanduliflora*, *Cassiope mertensiana* or other ericaceous dwarf shrubs O10
6c. Herb-dwarf shrub layer dominated by *Valeriana sitchensis*, *Erigeron peregrinus* or other herbs O9

III. KEY TO SHRUB VEGETATION TYPES

1a. *Abies lasiocarpa* (or occasionally *Picea engelmannii*) dominant shrub, snow avalanche path S2
1b. *Salix scouleriana* and *Alnus spp.* dominant shrubs, Jasper S6
1c. *Salix barrattiana* dominant shrub S8
1d. Various *Salix* spp., *Betula glandulosa* or *Betula pumila* dominant 2
2a. *Scirpus caespitosus* dominant herb S3
2b. *Kobresia myosuroides* dominant herb S9
2c. *Danthonia intermedia* dominant herb S11
2d. *Equisetum arvense* dominant herb S7
2e. None of the above 3
3a. *Potentilla fruticosa* usually present 4
3b. *Potentilla fruticosa* usually absent 5
4a. Bryoid cover dense, *Tomenthypnum nitens* present, *Arctostaphylos uva-ursi* usually hydric, level to gentle slope S1
4b. Bryoid cover sparse, *Tomenthypnum nitens* absent, *Arctostaphylos uva-ursi* usually present, site mesic to subxeric, moderate to steep slope S10
5a. *Elymus innovatus* cover $\geq$ 10%, *Salix barrattiana* usually absent S12
5b. *Elymus innovatus* cover <10%, *Salix barrattiana* usually present (5-20%) S4

IV. KEY TO LOW SHRUB-HERB VEGETATION TYPES

Dominant low shrub *Potentilla fruticosa* L1
Dominant low shrubs *Juniperus communis* and *Salix glauca*, snow avalanche path L2
Dominant low shrub *Cassiope tetragona*, snowbed L4
Dominant low shrubs *Phyllodoce glanduliflora* and *Cassiope mertensiana* L5
Dominant low shrub *Juniperus horizontalis* L6
Dominant low shrub *Salix arctica* L7

V. KEY TO HERB-DWARF SHRUB VEGETATION TYPES

1a. *Dryas* spp. dominant or codominant 2
1b. *Dryas* spp. not dominant 4
2a. *Dryas drummondii* dominant H8
2b. *Dryas integrifolia* dominant, *Carex rupestris* codominant, Jasper only. H15
2c. *Dryas octopetala* dominant, may contain *Dryas integrifolia* but *Carex rupestris* not codominant, see v.t. description for other differences. 3
3a. *Kobresia myosuroides*, *Arctostaphylos uva-ursi* codominant H4
3b. *Salix nivalis*, *Silene acaulis* codominant H1
4a. Elevation <1700 m, subxeric to xeric grasslands 5

4b Elevation mostly >1700 m, not subxeric to xeric grasslands.......8
5a *Agropyron* spp. dominant.......6
5b. *Agropyron* spp. not dominant.......7
6a *Agropyron dasystachyum* dominant, *Artemisia frigida* codominant.......H7
6b. *Agropyron spicatum* usually dominant, *Elymus innovatus* often codominant.......H19
7a *Koeleria cristata* dominant, *Artemisia frigida* codominant.......H6
7b. *Stipa richardsonii* dominant, *Koeleria cristata* codominant.......H13
8a. Site subhydric to hydric, very poorly drained.......9
8b. Site drier and better drained.......10
9a. *Eriophorum angustifolium* dominant.......H10
9b. *Carex aquatilis* or *Carex rostrata* dominant.......H11
9c. *Caltha leptosepala* and *Trollius albiflorus* codominant.......H9
10a. Lichens dominant, sparsely vegetated, high Alpine elevations.......H12
10b. Graminoids dominant.......11
10c. Forbs dominant.......14
11a. *Carex* spp. dominant.......12
11b. *Elymus innovatus* dominant.......13
12a. *Carex nigricans* dominant, Alpine snowbed.......H2
12b. *Carex scirpoidea* dominant, Montane-Lower Subalpine fluvial site.......H3
13a. *Fragaria virginiana, Epilobium angustifolium* abundant, site mesic.......H5
13b. *Koeleria cristata, Arctostaphylos uva-ursi* (*Hedysarum sulphurescens* in Banff) abundant, site subxeric.......H14
13c. *Saxifraga bronchialis* abundant, site xeric to subxeric.......H20
14a. Site subxeric to xeric, *Saxifraga bronchialis* and *Elymus innovatus* dominant.......H20
14b. Site mesic to hygric, *Saxifraga bronchialis* and *Elymus innovatus* usually absent.......15
15a. *Caltha leptosepala* and *Trollius albiflorus* dominant.......H9
15b. *Erigeron peregrinus* and *Valeriana sitchensis* dominant.......H16

SIGNIFICANT SPECIES

During the Ecological Land Classification, four species of vascular plants and two species of lichens new to Alberta were collected. *Hippuris montana* Ledeb. was collected in wet Alpine areas of western Jasper and occurs otherwise in Alaska, Yukon, Northwest Territories, British Columbia and Washington. *Sedum divergens* Watson was collected on rocky, Subalpine avalanche slopes in northern Jasper and occurs also in Washington, Oregon, British Columbia, and southeastern Alaska. *Tsuga heterophylla* (Raf.) Sarg. (western hemlock) was collected in moist *Picea engelmannii-Abies lasiocarpa* Subalpine forests along the Continental Divide in northern Banff and western Jasper. It ranges from southern Alaska to California, and interior British Columbia to northwestern Montana and western Alberta. *Vaccinium ovalifolium* J. E. Smith (oval-leaved blueberry) was collected in moist Lower Subalpine *Picea engelmannii-Abies lasiocarpa* forests in northern Banff and in northern and western Jasper. This wide ranging species also occurs in Alaska, Washington, Oregon, Idaho and western Montana as well as eastern North America and eastern Asia. The lichen *Caloplaca epithallina* Lynge was collected in dry Upper Subalpine grassland in both Banff and Jasper and occurs otherwise in New Mexico, Colorado, South Dakota, and Greenland. The other lichen, *Thelidium decipiens* (Nyl.) Kremp. was collected in the Alpine of Banff and is circumpolar, arctic-alpine in range. These six species all have small populations in the parks and are rare as defined below.

A list of rare species both vascular and nonvascular, was compiled. A rare vascular species is considered to occur within a restricted geographical area, usually <500 km², and at usually <10 collection sites. Also, the plant is often at the edge of its geographical range. All three criteria generally indicate a small population in the parks. In addition, a list of nearly rare plants and those with a range boundary in the parks was also compiled. The list of 152 rare vascular species and 28 nearly rare or range boundary species is in Volume II of this report along with information on occurrence in the parks. A list of 57 rare liverworts and mosses, and 30 rare lichens is also contained in Volume II. Further information on these species is in Volume II of this report. Due to a more limited knowledge of the ranges and abundances of nonvascular as compared to vascular plants, a slightly different definition of "rare" was used. The status "rare" was based on an abundance scale (dominant, common, infrequent, uncommon, rare) reflecting the quantity of the species in the parks as assessed by botanists familiar with the bryophytes and lichens of the Rocky Mountains.

WILDLIFE

The most spectacular, observable wildlife of Banff and Jasper National Parks are the eight species of ungulates. They occur in the parks primarily because of the availability of suitable habitat and the protection provided by the National Parks Act. Steep terrain and flat valley bottoms provide a variety of grasslands, shrub meadows and forests which, combined with moderate snow fall and areas of low snow accumulation, allow these species to forage in the winter. Much of the vegetated portion of the parks is used only in summer by elk, mule deer and white-tailed deer because winter snow accumulations are too deep for efficient travel and foraging. Part of the populations of these species is able to survive the winter within the parks, while the remainder winter outside the parks. Most sheep, goats, moose and caribou are resident in the parks year-round. Bison occurred in the mountains historically and recently one bull has survived in the lower Athabasca Valley in Jasper since 1978.

The number and variety of ungulates and other prey sustain a wide variety of carnivores. Wolves and coyotes are relatively common in Jasper. In Banff, wolves are relatively rare and most packs range east of the park, while coyotes are relatively common. Red foxes occur in both parks but are rare. Cougars are very rare, with most sightings near the townsites. Lynx are widespread but uncommon. There is a great variety of *Mustelidae*, the weasel family, in both parks. Martens and ermines are common in all forested areas. Fishers are rare and only occur in forests along the Continental Divide. Long-tailed weasels, least weasels and mink are uncommon throughout both parks. The present status of otters is not fully known but they are generally rare. Badgers have a spotty distribution in Banff.

Black bears and grizzly bears occur throughout both parks. Grizzlies are more common in the Front Ranges than the Main Ranges. Black bears have not been studied but appear to be more abundant in the Main Ranges and at lower elevations.

In addition, there are 34 other species of mammals that occur or have occurred in the two parks. There are four species of shrews; the water and pigmy shrews are rare. Seven species of bats have been recorded in in the parks. All are rare or uncommon but the big-brown and little-brown bats are the most common. Three species of lagomorphs have been recorded. Pikas and varying hares are relatively common and there is one specimen record of white-tailed jack rabbit. The remaining twenty species of mammals belong to the order *Rodentia*. The most common are deer mouse, Gapper's red-backed vole, red squirrel and Columbian ground squirrel. The Northern pocket gopher is suspected to occur only at the Ghost Lakes in Banff while the Richardson's water vole is rare but patchily distributed in both parks. Northern flying squirrels are present and widespread but their abundance is not known. Muskrats are restricted to low elevation ponds but beavers periodically invade valleys up to treeline.

Banff and Jasper National Parks support a wide variety of birds particularly during spring and summer. The great elevational range (1050 to 3350 m) and the varied terrain results in a diversity of habitats that contribute to the variety of birdlife. Also, species characteristic of both eastern and western Canada come into contact along the Rocky Mountains. So far, 281 species have been recorded in both parks.

Alpine species, such as white-tailed and willow ptarmigan, grey-crowned rosy finch, golden-crowned sparrow, water pipit and horned lark occur in most high elevation meadows. A few species of waterfowl breed at lower elevations. Many others migrate through the mountains in small to moderate numbers. Most notable among the raptors are the breeding population of golden eagles and the small autumn migration of prairie and peregrine falcons. Migrating shorebirds occur in small numbers on lakes at all elevations. Twelve species of owls have been recorded in the two parks but only eight appear to have bred here. Black swifts nest at Maligne and Johnston Canyons, the only known breeding sites in Alberta. Most species of warblers and vireos occur at low elevations while sparrows are distributed into the Alpine. Dippers inhabit most streams and in winter some are concentrated on the Bow River below Banff townsite. The seven species of corvids are among the most obvious of the parks' avifauna.

Amphibians and reptiles are less common than birds. Of the six species only the western toad is widespread. Wood frogs and spotted frogs breed in Montane and Subalpine ponds while the long-toed salamander is restricted to some Montane ponds. The boreal chorus frog occurs in the lowest portion of the Montane in the Athabasca Valley. Wandering garter snakes are rare even at the lowest elevations. The warm springs at the Cave and Basin in Banff provide the only known snake hibernaculum.

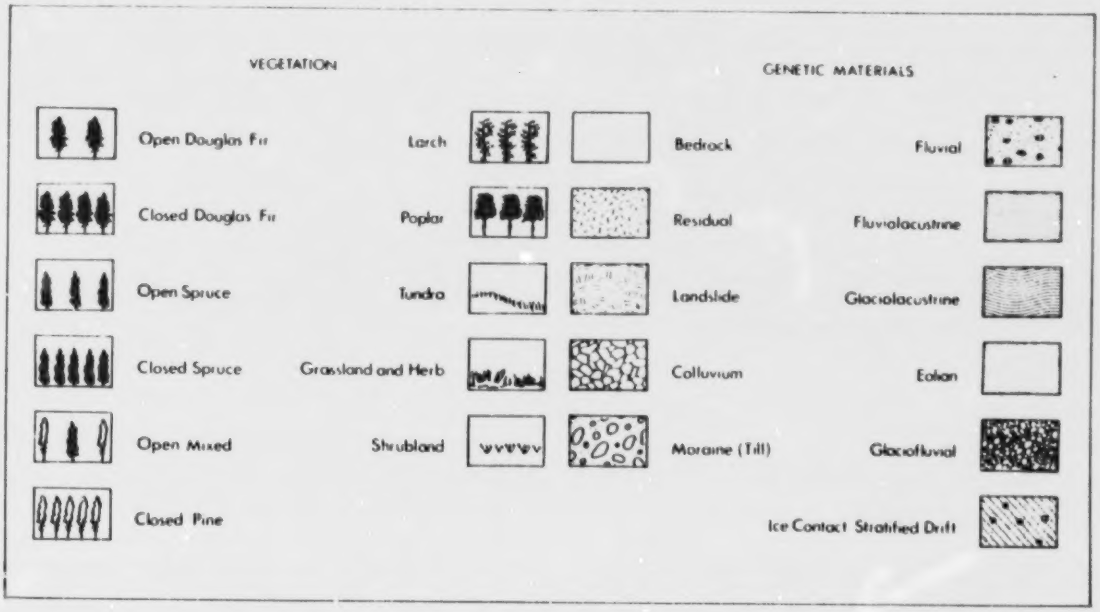
Further details on all species of wildlife are in the species accounts in Volume III and the bird checklist.

CHAPTER III - SUMMARY ECOSECTION/ECOSITE DESCRIPTIONS

ECOSYSTEM/ECOSITE DESCRIPTIONS..B.D. Walker, W.S. Taylor,
D.T. Allan, I.G.W. Corns and W.D. Holland
WILDLIFE..G.L. Holroyd and K.J. Van Tighem

The Ecosite descriptions in this section are abbreviated from the information given for soils and vegetation in Volume II, and wildlife in Volume III. They summarize the main features of these resources and are arranged alphabetically by the two letter abbreviation. Fig. 7 is a legend of the symbols used in the landscape schematics.

Fig 7. Legend of symbols used in Ecosite landscape schematics.


VEGETATION
GENETIC MATERIALS
Open Douglas Fir
Larch
Bedrock
Fluvial
Closed Douglas Fir
Poplar
Residual
Fluviolacustrine
Open Spruce
Tundra
Landslide
Glaciolacustrine
Closed Spruce
Grassland and Herb
Colluvium
Eolian
Open Mixed
Shrubland
Moraine (Till)
Glaciofluvial
Closed Pine
Ice Contact Stratified Drift

The interpretive comments in the Management Considerations section use a common or dominant element selected from the entire ecological concept of an Ecosection. For example, the effect of coarse texture is highlighted for glaciofluvial deposits such as AT or BV and the effect of poor drainage is emphasized in Ecosections like CV. Yet, the comments do not represent just one of the resource disciplines. Thus, the interpretive guidelines used in Waterton Lakes National Park or Yoho National Park may result in limitations for soils that are different than the evaluation used in Banff-Jasper where a more holistic ecological concept was adopted.

AL - ALTRUDE ECOSECTION

The Altrude (AL) Ecosection encompasses calcareous fluvial fan and apron landforms dominated by Brunisolic soils and lodgepole pine or Engelmann spruce-subalpine fir forests within the Lower Subalpine portion of the Subalpine Ecoregion. AL occurs primarily on lower slopes and floors of valleys. Two AL Ecosites are separated by vegetational differences as outlined in Table 17.

Table 17. General features of the AL Ecosites.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
AL1	Fan & apron	Fluvial material B (calcareous, coarse-stratified)	Eutric Brunisol	Lodgepole pine forest (C19)
AL 2	Fan & apron	Fluvial material B (calcareous, coarse-stratified)	Eutric Brunisol	Engelmann spruce - subalpine fir forest (C13,C31).

AL surfaces are often channeled. Slopes range from 2 to 45%. Orthic and Cumulic Regosols occur in narrow strips along present and recently abandoned stream channels. Soils are well to moderately well drained.

WILDLIFE

Table 18. Wildlife features of the AL Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
AL1	high	deer elk	high	wolverine lynx wolf cougar coyote	medium	snowshoe hare columbian ground squirrel golden-mantled ground squirrel western jumping mouse	medium
AL2	low	moose	high	coyote	medium	red squirrel red-backed vole porcupine	high

AL is moderately to highly important to wildlife. AL1 includes highly important habitat for some ungulates and carnivores while AL2 is highly important for coyotes. A large number of small mammal species occur in the AL Ecosection but only in moderate numbers. While both Ecosites receive moderate snowfall, AL1 is warmer because of more southerly exposure.

MANAGEMENT CONSIDERATIONS

AL tracts with gentle slopes generally have no landform, soil, or vegetational characteristics limiting campground, trail, or related uses. Locally occurring coarse textures and high water tables may present problems for sewage disposal; on the other hand, the coarse textured material provides gravel for construction.

Most of the AL tracts have streams that provide suitable domestic water supplies.

EACH TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

AT - ATHABASCA ECOSECTION

The Athabasca (AT) Ecosection encompasses terraced landforms of calcareous glaciofluvial material in the Montane Ecoregion. It is dominated by Brunisolic soils and either lodgepole pine forest or a pattern of dry grassland > lodgepole pine forest. Two Ecosites are separated on the basis of vegetational differences as outlined in Table 19. Representative landscape positions are shown in Figs. 24 and 27.

Table 19. General features of the AT Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
AT1	Terraced	Glaciofluvial material B (calcareous, coarse textured)	Eutric Brunisol	Lodgepole pine forest (C3, C6, C19)
AT3	Terraced	Glaciofluvial material B (calcareous, coarse textured)	Eutric Brunisol	Dry grassland (H6) > lodgepole pine forest (C3)

AT1 and AT3 occur on broad valley floors. The terraced surfaces are often channeled. Slopes range from 1 to 15%. A thin veneer of Eolian material B (altered, medium textured) occurs commonly in southern Banff and sporadically in southwestern Jasper; a thin veneer of Eolian material A (calcareous, medium textured) occurs from Jasper townsite eastward in the Athabasca River valley and near Saskatchewan Crossing in Banff. Soils are rapidly to well drained; many AT3 soils have a thin, surficial deposit of calcareous eolian material.

WILDLIFE

AT is very important to wildlife especially ungulates, carnivores and bats. Some small mammals also occur in large numbers. The relatively warm temperature and low snow

Table 20. Wildlife features of the AT Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
AT1	very high	elk deer	very high	cougar wolf coyote lynx	medium	bat snowshoe hare red squirrel deer mice	medium
AT3	very high	deer elk	high	weasel coyote wolf cougar	high	deer mouse	high

accumulation contribute to the suitability for wildlife. Critical ungulate habitat occurs on these Ecosites particularly when there are interspersed grasslands.

MANAGEMENT CONSIDERATIONS

Level topography and valley floor positions within the warm, dry Montane Ecoregion are conducive to many uses. The coarse textures provide extensive and readily available gravel and sand supplies. Because of ineffective ion filtration, AT should be tested before use for sewage disposal. Such coarse textures allow easy passage of water and thus, the soils are droughty, causing slow vegetation growth and problems in revegetation. In addition, AT is of limited areal extent and its unforested segments attract many uses.

AZ - AZURE ECOSECTION

The Azure (AZ) Ecosection has a dry > wet landscape pattern on hummocky and ridged landforms consisting of noncalcareous, coarse textured, ice contact stratified drift in the Upper Subalpine portion of the Subalpine Ecoregion. Dystric Brunisols and Engelmann spruce - subalpine fir open forest characterize dry (rapidly to well drained) upland segments. Wet (imperfectly to poorly drained) depressional segments are dominated by Gleysolic and Organic soils under wet shrub thicket and wet herb meadow vegetation. General features of the AZ1 Ecosite are outlined in Table 21. Its landscape position is shown in Fig. 8.

AZ1 occurs on lower slopes and floors of a few broad valleys. Slopes range from 5 to 45%. The strongly eluviated soils have thick Ae horizons, thick sola, and weakly cemented B horizons (duric tendency).

WILDLIFE

This Upper Subalpine Ecosite is moderately important to wildlife in summer. Deep snow restricts animal activity in winter.

Fig. 8. Landscape schematic of the Azure (AZ1) and Topaz (TZ1) Ecosites in relation to other Ecosites.

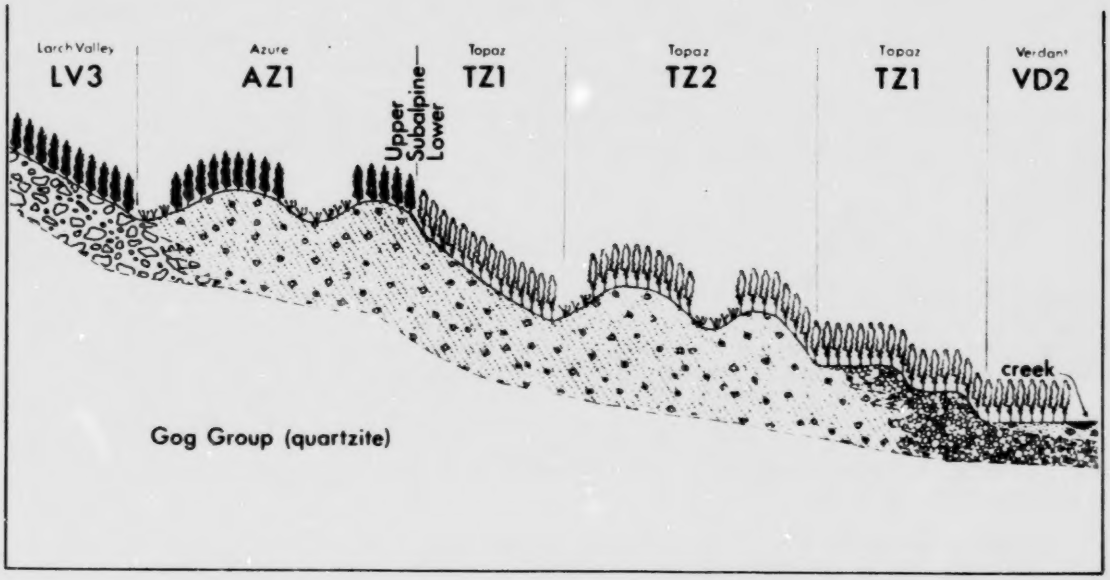

Larch Valley
LV3
Azure
AZ1
Upper
Subalpine
Lower
Topaz
TZ1
Topaz
TZ2
Topaz
TZ1
Verdant
VD2
creek
Gog Group (quartzite)

Table 21. General features of the AZ1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
AZ1	Hummocky & ridged	Ice contact stratified Drift A (noncalcareous, coarse textured)	Dry 70: Dystric Brunisol Wet 30: Gleysol > Mesisol	Engelmann spruce-subalpine fir open forest (O10) Wet shrub thicket (S8), wet herb meadow (H9)

MANAGEMENT CONSIDERATIONS

AZ1 is of limited areal extent. The coarse textured material provides gravel and sand for construction, but may present problems if used for sewage disposal because such coarse textured materials are ineffective ion filters. The dry > wet landscape pattern necessitates special considerations in trail locations and campsite construction. The

Table 22. Wildlife features of the AZ1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
AZ1	medium	caribou deer	low	cougar	low	heather vole yellow pine chipmunk	high

coarse textures are also expected to contribute to slow vegetation growth and regeneration.

BK - BAKER CREEK ECOSECTION

The Baker Creek (BK) Ecosection encompasses a dry > wet landscape pattern on ridged and hummocky landforms of calcareous glacial material in the Lower Subalpine portion of the Subalpine Ecoregion. Dry (well drained,) upland segments are dominated by an Eutric Brunisol > Gray Luvisol soil complex and lodgepole pine or Engelmann spruce - subalpine fir forests. Wet (poorly to very poorly drained) depressional segments are dominated by Gleysolic and Organic soils under wet spruce open forest, wet shrubby meadow, and birch fen. Three BK Ecosites are differentiated by genetic material and vegetational differences as outlined in Table 23. Relative landscape positions are shown in Fig. 9.

Slopes commonly range from 5 to 45%. Surficial veneers of Eolian material B (altered, medium textured) occur extensively in western Banff and southwestern Jasper, sporadically elsewhere. BK Ecosites usually occur on the benchland of broad river valley floors.

WILDLIFE

BK is highly important to wildlife. Although deep snow limits use by large mammals in winter, many species occur here in large numbers in the summer. All BK Ecosites are important to moose year-round. The mosaic of wet and dry habitats contributes to the importance of this Ecosection to wildlife.

MANAGEMENT CONSIDERATIONS

Dry portions of BK1 generally have no landform, soil or vegetational limitations for campgrounds, trails or related uses. However, the characteristic dry > wet landscape pattern necessitates special considerations in trail location and construction. BK4 and BK6 have locally occurring coarse textured materials that provide gravel sources but, conversely, may present problems in sewage disposal because of ineffectiveness in ion filtration.

BP - BOULDER PASS ECOSECTION

The Boulder Pass (BP) Ecosection encompasses hummocky landslide landforms in the Upper Subalpine portion of the Subalpine Ecoregion. Brunisolic and Regosolic soils dominate along with mixed coniferous open forest, Engelmann spruce-subalpine fir open and closed forest, and subalpine larch - subalpine fir forest. Two BP Ecosites are differentiated by soil and vegetation characteristics as outlined in Table 25.

Table 23. General features of the BK Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
BK1	Hummocky & ridged including bedrock control(blanket)	Till C (calcareous, medium textured)	Dry 70: Eutric Brunisol > Gray Luvisol Wet 30: Gleysol, Mesisol	Lodgepole pine forest (C18,C19) Wet spruce open forest (O11), wet shrubby meadow(S1), birch fen (S3)
BK4	Hummocky & ridged including bedrock control (blanket)	Ice contact stratified Drift B (calcareous, variably textured)	Dry 70: Eutric Brunisol > Gray Luvisol Wet 30: Gleysol, Mesisol	Lodgepole pine forest (C18, C19) Wet spruce open forest (O11), wet shrubby meadow (S1), birch fen (S3)
BK6	Hummocky & ridged including bedrock control (blanket)	Till C (calcareous, medium texture) & Ice contact stratified Drift B (calcareous, variably textured)	Dry 70: Eutric Brunisol Wet 30: Gleysol, Mesisol	Engelmann spruce - subalpine fir forest (C13) Wet spruce open forest (O11), wet shrubby meadow (S1), birch fen (S3)

Relative landscape positions are shown in Fig. 10.

Surfaces are often stony and bouldery. Slopes are usually complex and range from 15 to 70%. Veneers of Eolian material B (altered, medium textured) are common on BP2 tracts in western Banff and southwestern Jasper. Soils are rapidly to moderately well drained. Eutric Brunisols occur on calcareous materials, Dystric Brunisols on noncalcareous materials. Occurrences of subalpine larch - subalpine fir forest (C23) are restricted to southern Banff. Unvegetated portions may constitute up to 50% of BP1 tracts.

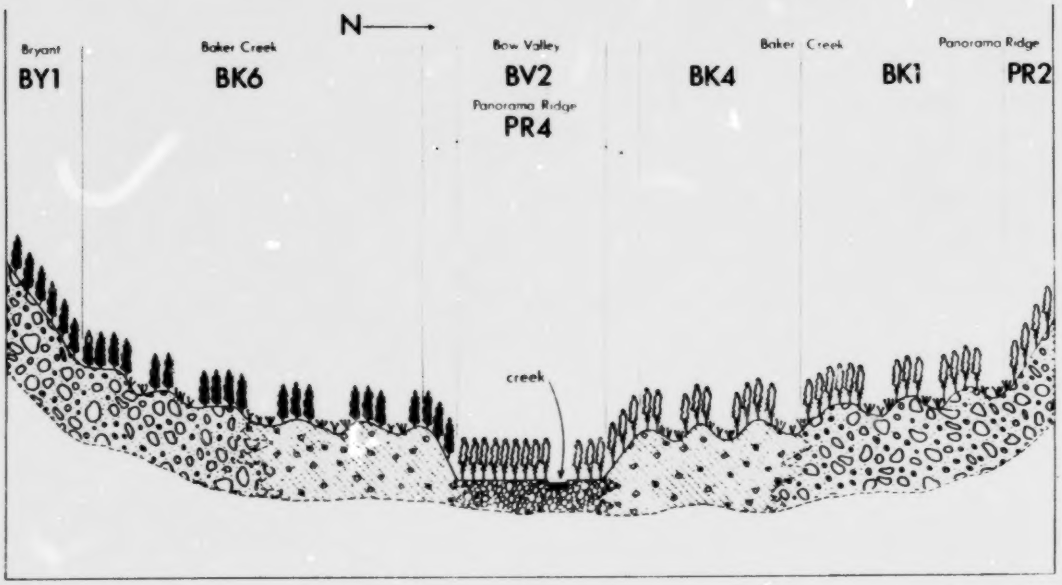
WILDLIFE

This Ecosection is of low importance to wildlife with the exception of goats. Goats forage here and probably rest in BP tracts during winter storms where BP areas occur adjacent to better foraging land. In addition, a few small mammal species occur here in high densities.

MANAGEMENT CONSIDERATIONS

BP1 has irregular topography, moderate to steep slopes, and rubbly, blocky surfaces that are limiting for campgrounds and related uses and should be considered when planning trails and roads. Vegetation is expected to recover slowly from disturbances, including fire. BP2 has limiting factors similar to those of BP1 but not as severe because fine earth materials thinly mantle the rubbly, blocky landslide deposits. As a result, the closed to open forest is thought to be more resilient to surface distrubances.

Fig. 9. Landscape schematic of the Baker Creek (BK) Ecosites in relation to other Ecosites.



BS - BOW SUMMIT ECOSECTION

The Bow Summit (BS) Ecosection encompasses inclined landforms consisting of calcareous, medium textured colluvium in the Alpine Ecoregion. It is dominated by Brunisolic and Regosolic soils and mountain avens tundra vegetation. The features of BS1 are outlined in Table 27. The landscape position of BS1 is shown in Figs. 28 and 30.

BS1 occurs on steep, usually linear slopes in areas dominated by calcareous bedrock. Slopes range from 45 to 100%. Colluvial processes are locally active and include avalanching, soil creep, cryoturbation, and solifluction. Soils are well drained. Unvegetated portions may occupy up to 50% of BS1 tracts.

WILDLIFE

This Ecosite is of low importance to most species but highly important to ungulates and some small mammals. The major attraction for ungulates is the lack of deep winter snow in these windswept areas. Rocky areas are highly important to pika and golden-mantled ground squirrels while finer soils are highly important to marmot and columbian-ground squirrel.

Table 24. Wildlife features of the BK Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
BK1	medium	moose deer elk	high	marten wolverine coyote wolf cougar	high	masked shrew red squirrels red-backed vole meadow vole western jumping mouse	high
BK4	high	elk deer moose	very high	wolf cougar coyote marten lynx	medium	snowshoe hare red-backed vole	medium
BK6	low	moose	very high	coyote marten lynx cougar	medium	snowshoe hare red-backed vole	medium

MANAGEMENT CONSIDERATIONS

Steep and locally unstable (colluviating) slopes are limiting factors for many park uses. Removal of vegetation is likely to result in wind, water, and gravitational erosion. Vegetation is expected to recover slowly from disturbances.

BV - BOW VALLEY ECOSECTION

The Bow Valley (BV) Ecosection consists of terraced landforms of calcareous glaciofluvial material and occurs in the Lower Subalpine portion of the Subalpine Ecoregion. It is dominated by Brunisolic soils and either lodgepole pine or Engelmann spruce-subalpine fir forest. Three BV Ecosites are separated by vegetational differences as outlined in Table 29. Landscape positions are shown in Fig. 11.

The BV Ecosites generally occur on broad valley floors. The terraced surfaces are often channeled. Slopes range from 1 to 15%. A thin veneer of Eolian material B (altered, medium textured) is common in western Banff and southwestern Jasper. Soils are rapidly to well drained.

WILDLIFE

This Ecosection is moderately important to wildlife. Although some species occur in high numbers, this Ecosection has less wildlife than most other Montane Ecosections.

MANAGEMENT CONSIDERATIONS

Level topography and valley floor positions are conducive to many uses. The coarse textures provide extensive and readily available gravel supplies but such coarse textured material is ineffective as an ion filter, a factor to be considered when designing sewage disposal systems. Water easily passes through these materials and and

Fig. 10 Landscape schematic of the Boulder Pass (BP) Ecosites in relation to other Ecosites.

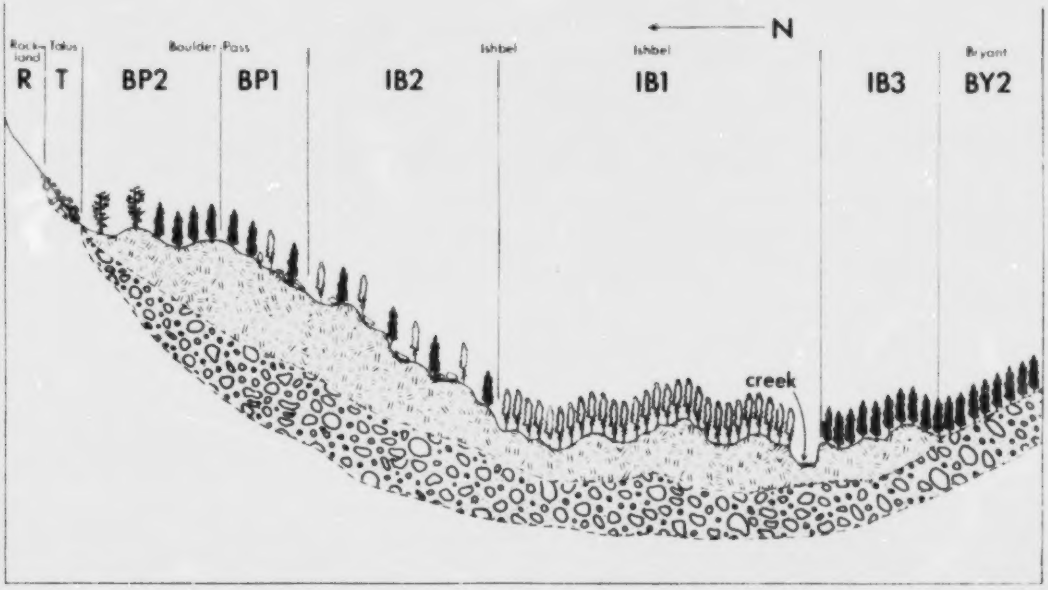

N
Rockland
Talus
Boulder Pass
Ishbel
Ishbel
Bryant
R
T
BP2
BP1
IB2
IB1
IB3
BY2
creek

Table 25. General features of the BP Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
BP 1	Hummocky	Landslide material (variable calcareousness and texture)	Eutric & Dystric Brunisol, Regosol	Mixed coniferous open forest (O4)
BP 2	Hummocky	Landslide material (variable calcareousness and texture)	Eutric Brunisol	Engelmann spruce-subalpine fir closed & open forest (C15, O10), subalpine larch-subalpine fir forest (C23).

problems in revegetation may occur. Vegetational growth rates are slow.

Table 26. Wildlife features of the BP Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
BP1	medium	mountain goat	low	marten weasel	medium	dusky shrew pika columbian ground squirrel northern bog lemming long-tailed vole	low
BP2	medium	mountain goat	low		low	least chipmunk heather vole	low

Table 27. General features of the BS1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
BS1	Blanket & veneer over inclined bedrock	Colluvium C. (calcareous, medium textured)	Eutric & Melanic Brunisol, Regosol, Humic Regosol	Mountain avens tundra (H1).

Table 28. Wildlife features of the BS1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
BS1	high	bighorn sheep mountain goat	low		low	pika hoary marmot columbian ground squirrel golden-mantled ground squirrel	low

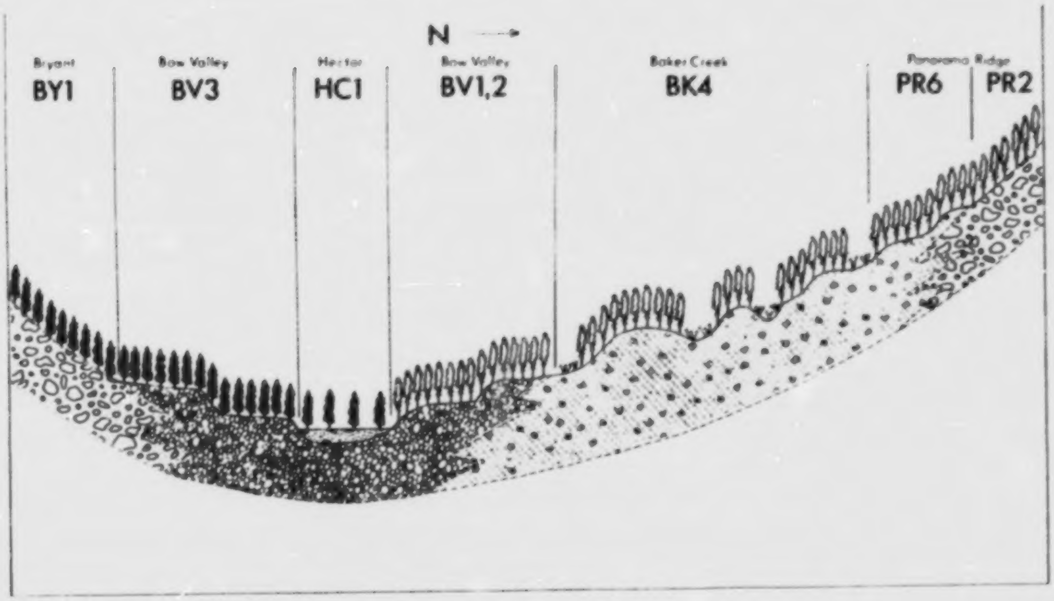
BY - BRYANT ECOSECTION

The Bryant (BY) Ecosection encompasses calcareous glacial landforms dominated by Engelmann spruce-subalpine fir forest in the Lower Subalpine portion of the Subalpine

Table 29. General features of the BV Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
BV 1	Terraced	Glaciofluvial material B (calcareous, coarse textured)	Eutric Brunisol	Lodgepole pine forest (C9, C18, C19)
BV 2	Terraced	Glaciofluvial material B (calcareous, coarse textured)	Eutric Brunisol	Lodgepole pine forest (C20, C29)
BV 3	Terraced	Glaciofluvial material B (calcareous, coarse textured)	Eutric Brunisol	Engelmann spruce - subalpine fir forest (C13, C30)

Fig. 11 Landscape schematic of the Bow Valley (BV) Ecosites in relation to other Ecosites


N →
Bryant
BY1
Bow Valley
BV3
Hector
HC1
Bow Valley
BV1,2
Baker Creek
BK4
Panorama Ridge
PR6
PR2

Ecoregion. Eutric Brunisols are the dominant soils. Three BY Ecosites are

Table 30. Wildlife features of the BV Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
BV1	medium	moose	high	coyote lynx	medium	snowshoe hare red squirrel meadow vole porcupine	high
BV2	low		medium	marten	medium	red-backed vole	high
BV3	low	deer moose	low	wolf cougar	high	masked shrew red-backed vole western jumping mouse	low

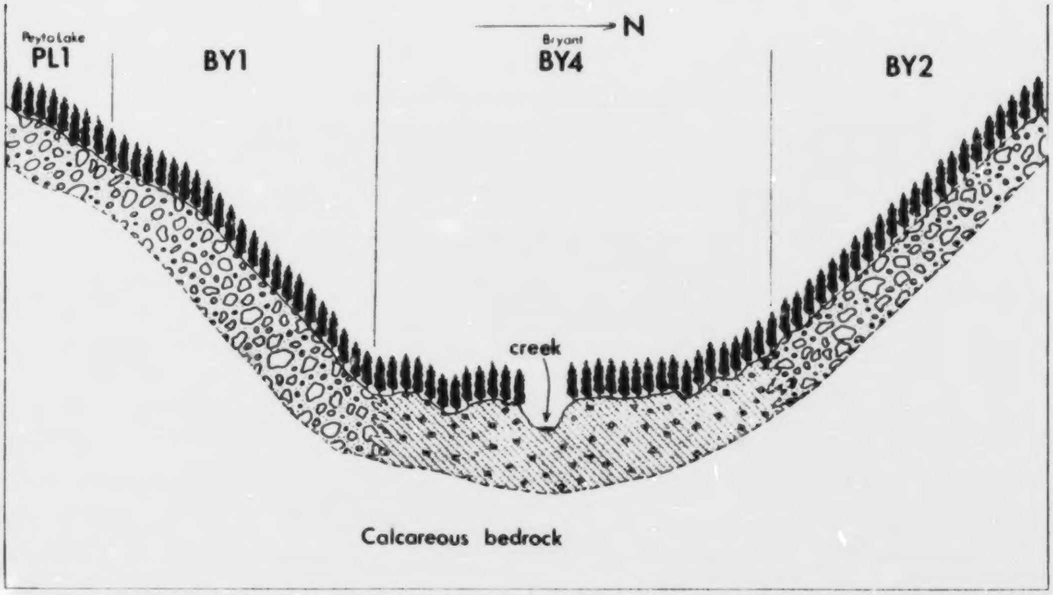
differentiated by genetic material, soil, and vegetational distinctions as outlined in Table 31. Landscape positions are shown in Fig. 12.

Table 31. General features of the BY Ecosites.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
BY1	Blanket over inclined bedrock	Till C (calcareous, medium textured)	Eutric Brunisol > Humo-Ferric Podzol	Engelmann spruce - subalpine fir forest (C14, C21)
BY2	Blanket over inclined bedrock	Till C (calcareous, medium textured)	Eutric Brunisol	Engelmann spruce - subalpine fir forest (C13, C30, C31)
BY4	Blanket over inclined and hummocky bedrock, hummocky	Ice contact stratified Drift B (calcareous, variably textured)	Eutric Brunisol	Engelmann spruce - subalpine fir forest (C13, C14, C30)

BY1 occurs most often on northerly aspects in western Banff and Jasper; BY2 occurs most often in eastern Banff and Jasper. Slopes range from 15 to 70% and are often gullied on BY1 and BY2, 5 to 45% for BY4. Surficial veneers of Eolian material B (altered, medium textured) occur extensively in western Banff and Jasper and are therefore most abundant on BY1. The development of Bf, podzolic Bf, and similar horizons is related to the occurrence of Eolian material B. Soils are well to moderately well drained.

Fig. 12 Landscape schematic of the Bryant (BY) Ecosite in relation to other Ecosites.



WILDLIFE

This Ecosection is moderately important to wildlife. BY2 is highly important to caribou in Jasper. Snowshoe hare and lynx are common on BY2 and BY4. Breeding birds typical of subalpine spruce-fir forest occur in high densities in this Ecosection.

MANAGEMENT CONSIDERATIONS

Steepness of slope is a factor to consider in planning park uses. Eolian material B veneers are extensive on many BY1 tracts and tend to erode easily where vegetation is removed. Locally occurring avalanche paths and seeps may affect certain park uses on BY1 and BY2. BY4 has no characteristics limiting for campgrounds, trails or related uses. Locally occurring gravel sources on BY4 may present problems if such sites are used for sewage disposal (ineffective ion filtration).

BZ - BRAZEAU ECOSECTION

The Brazeau (BZ) Ecosection encompasses hummocky residual landforms within the Lower Subalpine portion of the Subalpine Ecoregion. It is dominated by lithic Brunisolic

Table 32. Wildlife features of the BY Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
BY1	low	moose	medium		high	red-backed vole porcupine	high
BY2	medium	caribou moose	high	lynx coyote	medium	snowshoe hare red-backed vole porcupine	low
BY4	low		high	marten lynx	low	snowshoe hare	high

soils and Engelmann spruce-subalpine fir or lodgepole pine forests. Two BZ Ecosites are separated by vegetational differences as outlined in Table 33.

Table 33. General features of the BZ Ecosites.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
BZ 1	Hummocky	Residuum A (noncalcareous medium textured) and Residuum B (calcareous, medium textured)	Eutric and Dystric Brunisol (lithic phases)	Engelmann spruce - subalpine fir forest (C30, C31)
BZ 2	Hummocky	Residuum A (noncalcareous, medium textured) and Residuum B (calcareous, medium textured)	Eutric and Dystric Brunisol (lithic phases)	Lodgepole pine forest (C18, C29)

The landforms usually consist of failed Mesozoic shale bedrock that now occupies valley floor and lower slope positions. Slopes range from 5 to 15% on BZ1 and 15 to 45% on BZ2. Soils are well drained. Dystric Brunisols are associated with Residuum A; Eutric Brunisols with Residuum B. BZ occurs only in Jasper.

WILDLIFE

BZ is moderately important to wildlife but highly important to small mammals, moose and deer. Red-backed vole occurs in high densities here.

Table 34. Wildlife features of the BZ Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
BZ1	medium	moose deer	medium	weasel	high	deer mouse red-backed vole	low
BZ2	medium	moose deer	low	marten	high	red-backed vole	medium

MANAGEMENT CONSIDERATIONS

BZ1 and BZ2 are of very limited areal extent. Shallow soils and bedrock are the major factors to consider in planning of park uses.

CA - CAVELL ECOSECTION

The Cavell (CA) Ecosection encompasses morainal landforms consisting of noncalcareous, medium textured till within the Lower Subalpine portion of the Subalpine Ecoregion. It is dominated by Dystric Brunisols and Engelmann spruce-subalpine fir or lodgepole pine forests. Three CA Ecosites are separated by a dry > wet landscape pattern and vegetational differences as outlined in Table 35. Landscape positions are shown in Fig. 13.

The dry > wet CA1 frequently includes failed slopes and occurs on valley floors including benchlands and on lower valley wall slopes. A few CA1 tracts are dominated by Till A (noncalcareous, coarse textured), a few others by a medium textured variant of Ice Contact Stratified Drift A (noncalcareous, coarse textured). Slopes range from 5 to 45%. Dry segments have well to moderately well drained soils; wet segments have poorly to very poorly drained soils.

Slopes for CA2 and CA4 range from 15 to 70%; soils of these two Ecosites are well to moderately well drained.

Surficial veneers of Eolian material B (altered, medium textured) occur extensively on CA1 and CA2 in western Banff and southwestern Jasper, sporadically on CA4. Occasional occurrences of Humo-Ferric Podzols are associated with the eolian veneers.

WILDLIFE

This Ecosection is moderately important to wildlife. It is highly important to some carnivores and small mammals. Deep winter snow restricts large mammal activity.

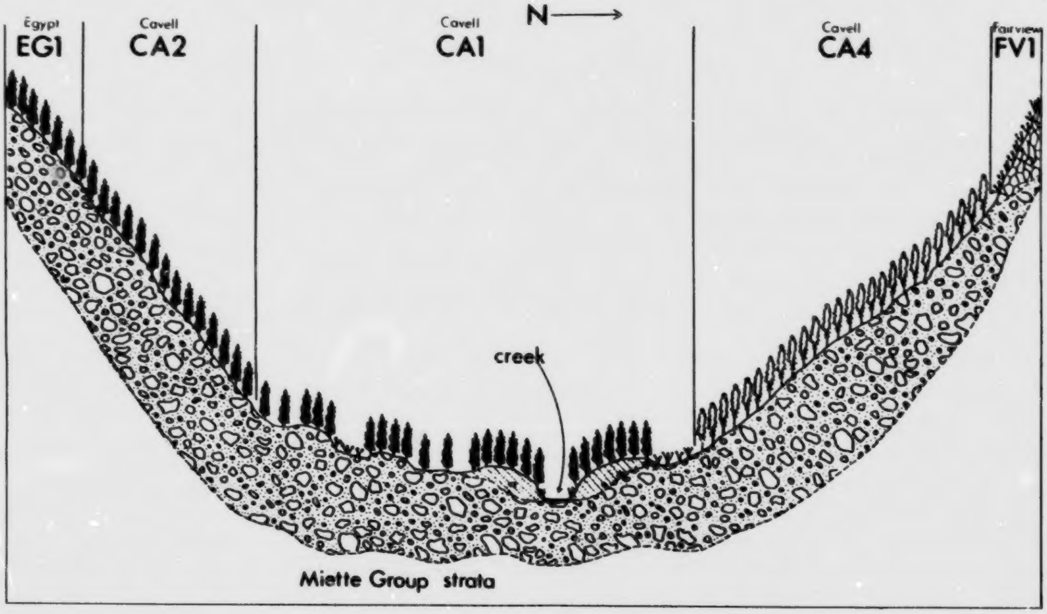
MANAGEMENT CONSIDERATIONS

Dry portions of CA1 have no characteristics limiting for campgrounds, trails, or related park uses. The characteristic dry > wet landscape requires special considerations in trail location and construction. Removal of surface and subsurface materials may

Table 35. General features of the CA Ecosites.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
CA1	Hummocky & ridged including bedrock control (blanket)	Till B (noncalcareous, medium textured)	Dry 70: Dystric Brunisol Wet 30: Gleysol, gleyed Podzolic, Mesisol	Engelmann spruce - subalpine fir forest (C14, C13, C21) Wet spruce open forest (O11), wet Engelmann spruce-subalpine fir open forest (O14), wet shrubby meadow (S1), birch fen (S3).
CA2	Blanket over inclined bedrock	Till B (noncalcareous, medium textured)	Dystric Brunisol	Engelmann spruce - subalpine fir forest (C14, C13, C21).
CA4	Blanket over inclined bedrock	Till B (noncalcareous, medium textured)	Dystric Brunisol	Lodgepole pine forest (C19, C20).

Fig. 13 Landscape schematic of the Cavell (CA) Ecosites in relation to other Ecosites.



create seepage-induced slope failure. Steepness of slope is the major factor to consider in planning park uses for CA2 and CA4. Also, avalanche paths and seeps will affect certain uses locally.

Table 36. Wildlife features of the CA Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
CA1	medium		high	marten weasel lynx	medium	masked shrew snowshoe hare red-backed vole	high
CA2	low		high	marten lynx	medium	snowshoe hare red-backed vole	medium
CA4	medium	moose	medium	marten	medium	deer mice red-backed vole	low

CN - CYCLONE ECOSECTION

The Cyclone (CN) Ecosection encompasses fluvial fan and apron landforms dominated by Regosolic soils and dry to moist shrub thicket vegetation in the Upper Subalpine portion of the Subalpine Ecoregion. It occurs on valley floors and lower slopes mainly within the Front Ranges. The features of the CN1 Ecosite are outlined in Table 37. Landscape position is shown in Fig. 30.

Table 37. General features of the CN1 Ecosite.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
CN1	Fan, apron	Fluvial materials A & B (noncalcareous & calcareous, coarse-stratified)	Regosol, Humic Regosol	Dry shrub thicket (S10), moist shrub thicket (S12)

Fluvial blankets, terraces, and level floodplains occur in minor amounts. Modification by snow avalanching and channeling is common. Slopes range from 5 to 45%. Soils are well to moderately well drained although some tracts contain small wet sites.

WILDLIFE

Table 38. Wildlife features of the CN1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
CN1	high	elk	low	coyote cougar	high	columbian ground squirrel deer mouse heather vole meadow vole long-tailed vole	low

This shrubby Ecosection is highly important to all wildlife, particularly small mammals and, in summer and autumn, elk.

MANAGEMENT CONSIDERATIONS

Regosolic soils dominate, therefore flooding is sufficiently frequent to maintain these weakly developed soils. Frequency and magnitude of depositional processes are major factors to consider in planning park uses. Locally occurring coarse textures and high water tables present problems for sewage disposal. Coarse textured materials provide gravel supplies. Many tracts are avalanched.

EACH TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

CP - COPPER ECOSECTION

The Copper (CP) Ecosection encompasses residual landforms in the Upper Subalpine portion of the Subalpine Ecoregion. It is dominated by lithic Dystric Brunisols and Engelmann spruce-subalpine fir open and closed forests and subalpine larch-subalpine fir forest. The features of the CP1 Ecosite are outlined in Table 39. Landscape position is shown in Fig. 14.

CP1 occurs primarily on valley shoulders and spurs; some tracts occur on failed bedrock. The parent material is weathered from either Miette Group bedrock in the Main Ranges or noncalcareous Mesozic strata in the Front Ranges. Surficial veneers of Eolian material B (altered, medium textured) occur extensively in western Banff, sporadically elsewhere. Limited occurrences of Humo-Ferric Podzols are associated with the eolian veneers. Slopes range from 15 to 60%. Soils are well to moderately well drained. Occurrences of subalpine larch-subalpine fir forest (C23) are restricted to southern Banff.

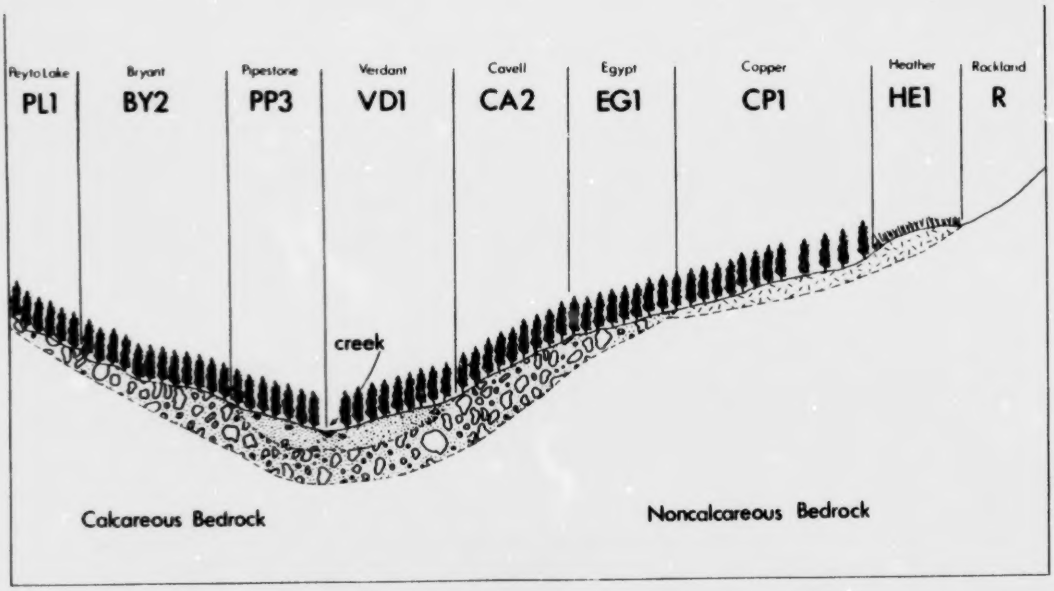
WILDLIFE

This rocky Ecosection is moderately important to wildlife, although few species occur here in large numbers.

Table 39. General features of the CP1 Ecosite.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
CP1	Inclined, hummocky, & ridged	Residuum A (noncalcareous, medium textured)	Dystric Brunisol (lithic phases)	Engelmann spruce - subalpine fir closed & open forest (C15, O10), subalpine larch - subalpine fir forest (C23)

Fig. 14 Landscape schematic of the Copper (CP1) Ecosite in relation to other Ecosites.


Peyto Lake
PL1
Bryant
BY2
Pipestone
PP3
Verdant
VD1
Cavell
CA2
Egypt
EG1
Copper
CP1
Heather
HE1
Rockland
R
creek
Calcareous Bedrock
Noncalcareous Bedrock

MANAGEMENT CONSIDERATIONS

CP1 is of limited areal extent. Shallow soils and bedrock are the major factors to consider when planning park uses.

Table 40. Wildlife features of the CP1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
CP1	medium	bighorn sheep caribou	medium	weasel	low	heather vole	medium

CV - CONSOLATION VALLEY ECOSECTION

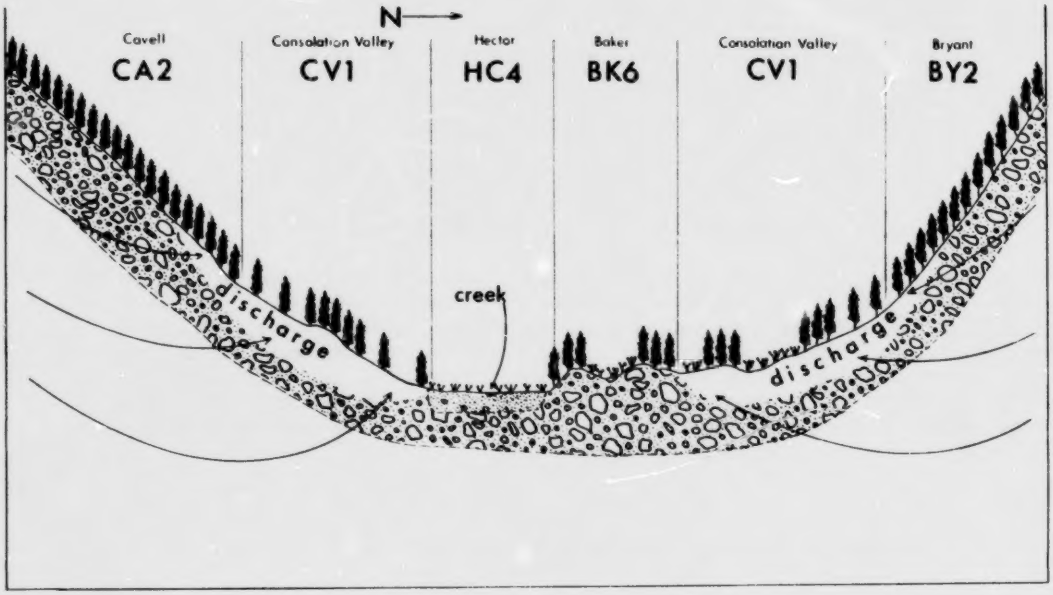
The Consolation Valley (CV) Ecosection encompasses a wet > dry landscape pattern on glacial landforms in the Lower Subalpine portion of the Subalpine Ecoregion. Wet (poorly to very poorly drained) segments are dominated by Gleysolic, gleyed Podzolic, and Organic soils under wet Engelmann spruce-subalpine fir open forest, wet spruce open forest, wet shrubby meadow, and birch fen vegetation. Dry (well to moderately well drained) segments are dominated by Brunisolic soils occurring under Engelmann spruce-subalpine fir or lodgepole pine forests. Features of the CV1 Ecosite are outlined in Table 41. Landscape position is shown in Fig. 15.

Table 41. General features of the CV1 Ecosite.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
CV1	Inclined, hummocky, & ridged including bedrock control (blanket) > sloping fen	Till B (noncalcareous, medium textured) & low lime phase of Till C (calcareous, medium textured) > fen peat	Wet 80: Gleysol, gleyed Podzolic, Mesisol Dry 20: Eutric & Dystric Brunisol	Wet spruce open forest (O11), wet Engelmann spruce - subalpine fir open forest (O14) > wet shrubby meadow (S1), birch fen (S3). Engelmann spruce - subalpine fir forest (C13), lodgepole pine forest (C20, C29)

CV1 tracts occur in groundwater discharge areas, often on valley floors and lower valley wall slopes; seepage is characteristic. Other genetic materials that dominate a few CV1 tracts include Till A (noncalcareous, coarse textured), Ice Contact Stratified Drift B (calcareous, variably textured), and Ice Contact Stratified Drift A (noncalcareous, coarse textured). Postglacial slope failure is a common feature of CV1 landforms. Slopes commonly range from 5 to 45%. Surficial veneers of Eolian material B (altered, medium textured) and Fluviolacustrine material A (altered, fine-stratified) occur extensively in western Banff and southwestern Jasper.

Fig. 15 Landscape schematic of the Consolation Valley (CV1) Ecosite in relation to other Ecosites.


N
Cavell
CA2
Consolation Valley
CV1
Hector
HC4
Baker
BK6
Consolation Valley
CV1
Bryant
BY2
creek
discharge
discharge

WILDLIFE

Table 42. Wildlife features of the CV1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
CV1	medium	moose	very high	coyote marten weasel wolverine	high	yellow pine chipmunk meadow vole porcupine	high

CV1 is highly important to wildlife. Although moose is the only ungulate to make much use of this Ecosite, many species of other mammals and birds occur here in large numbers.

MANAGEMENT CONSIDERATIONS

Poor to very poor drainage resulting from seepage and groundwater discharge limits most land uses unless expensive construction techniques are followed. Of particular consideration is the hydrologic importance of CV in maintaining and regulating stream flow.

Evidence of postglacial slope failure suggests that this may recur.

DV - DEVONA ECOSECTION

The Devona (DV) Ecosection encompasses ridged (dune) landforms of calcareous eolian material in the Montane Ecoregion in Jasper, in particular along the Athabasca River valley floor downstream from Jasper Lake. Regosolic soils are associated with white spruce forest or shrubby grassland. Two DV Ecosites are separated by vegetational differences (Table 43). Landscape position is shown in Fig. 16.

Table 43. General features of the DV Ecosites.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
DV1	Ridged	Eolian material A (calcareous, medium textured).	Regosol	Shrubby grassland (L6).
DV2	Ridged	Eolian material A (calcareous, medium textured).	Regosol	White spruce forest (C27).

The eolian material is actively aggrading, particularly on DV1. Unvegetated blowouts are associated with active wind erosion. Slopes range from 5 to 30%. White spruce thickets occupy moist depressions between ridges on DV1. Soils are rapidly to well drained and extremely calcareous. Cumulic Regosols in the DV2 Ecosite indicate periods of geomorphic inactivity interspersed with periods of eolian deposition.

WILDLIFE

DV is very important to wildlife. In winter, it is critical range for deer and elk. Consequently, large carnivores are also concentrated adjacent to these grasslands. Some breeding birds occur here in high densities.

Fig. 16 Landscape schematic of the Devona 1 (DV1) Ecosite in relation to other Ecosites.

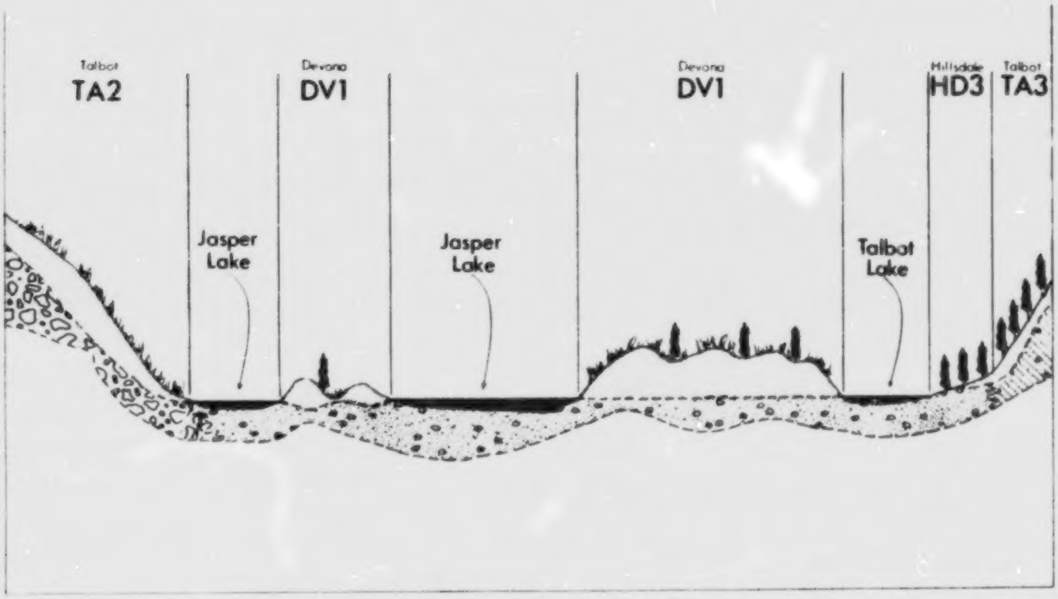

Talbot
TA2
Devona
DV1
Devona
DV1
Hillsdale
HD3
Talbot
TA3
Jasper Lake
Jasper Lake
Talbot Lake

Table 44. Wildlife features of the DV Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
DV1	very high	elk deer	high	wolf weasel coyote lynx	medium	deer mouse	medium
DV2	very high	elk deer	high	wolf coyote cougar	high	deer mouse	high

MANAGEMENT CONSIDERATIONS

DV1 and DV2 are of limited areal extent. Regosolic soils dominate and indicate current and recent eolian deposition. Removal of vegetation is likely to result in wind erosion. With disturbance, vegetation is easily removed and slow to recover. However, vegetation of DV2 is more resilient than that of DV1.

EF - EIFFEL ECOSECTION

The Eiffel (EF) Ecosection encompasses morainal landforms comprised of noncalcareous, coarse textured till within the Alpine Ecoregion. Dystric and Sombric Brunisols and Podzols characterize the soils. The vegetation is dominantly heath tundra. General features of the EF1 Ecosite are outlined in Table 45 and landscape position is shown in Fig. 21.

Table 45. General features of the EF1 Ecosite.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
EF1	Blanket & veneer over inclined, hummocky and ridged bedrock	Till A (noncalcareous, coarse textured)	Dystric & Sombric Brunisol, Ferro-Humic Podzol	Heath tundra (L5)

EF1 occurs in the Main Ranges and is associated primarily with Gog Group strata. Surficial veneers of Eolian material B (altered, medium textured) occur on EF1 tracts in western Banff and southwestern Jasper. Podzolic soils are associated with these veneers. Slopes range from 5 to 45%. Soils are well drained. Lithic soil phases occur.

WILDLIFE

Table 46. Wildlife features of the EF1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
EF1	low	caribou mountain goat	low		medium	dusky shrew hoary marmot columbian ground squirrel golden-mantled ground squirrel heather vole	low

EF1 is of low importance to wildlife.

MANAGEMENT CONSIDERATIONS

Heath tundra vegetation is slow to recover from disturbances. Stony surfaces in some localities will affect trail and campsite construction.

EG - EGYPT ECOSECTION

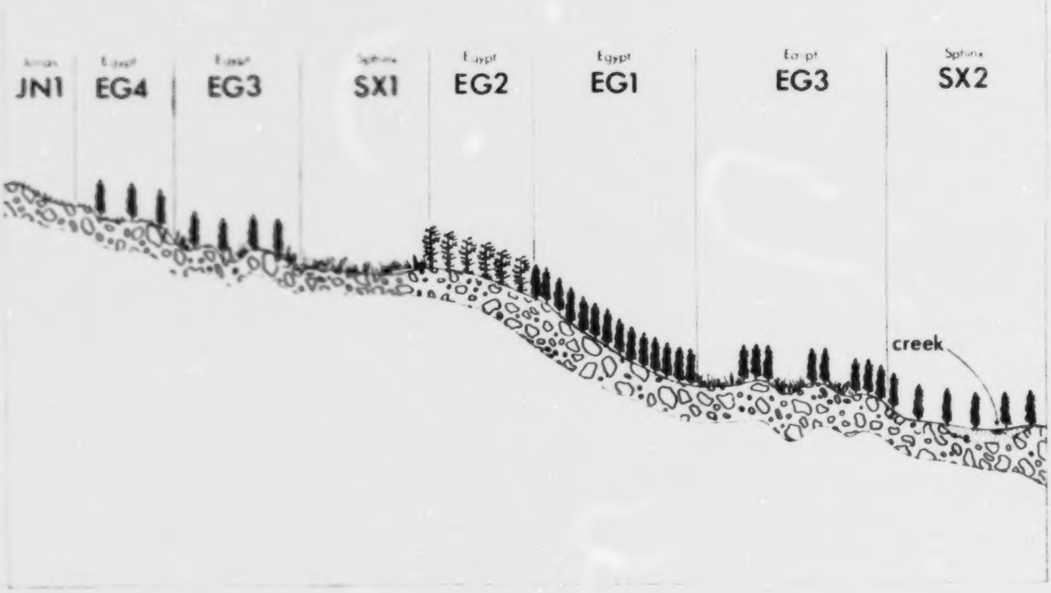
The Egypt (EG) Ecosection encompasses morainal landforms comprised of noncalcareous, medium textured till within the Upper Subalpine portion of the Subalpine Ecoregion. Dystric Brunisols are the dominant soils and occur under Engelmann spruce-subalpine fir closed and open forest, subalpine larch-subalpine fir forest, and a pattern of heath tundra plus coniferous open forest. The four EG Ecosites outlined in Table 47 are seperated by vegetational differences and a dry > wet landscape pattern. Landscape positions are shown on Fig. 17.

Table 47. General features of the EG Ecosites.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
EG1	Blanket over inclined bedrock	Till B (noncalcareous, medium textured)	Dystric Brunisol	Engelmann spruce-subalpine fir closed & open forest (C15, C21, O10).
EG2	Blanket over inclined, hummocky, & ridged bedrock	Till B (noncalcareous, medium textured)	Dystric Brunisol > Humo-Ferric Podzol	Subalpine larch - subalpine fir forest (C23)
EG3	Blanket & veneer over hummocky & ridged bedrock	Till B (noncalcareous, medium textured)	Dry 70: Dystric Brunisol	Engelmann spruce - subalpine fir closed & open forest (C15,O10), subalpine larch-subalpine fir forest (C23)
			Wet 30: Gleysol, gleyed Podzolic, gleyed Brunisolic	Engelmann spruce - subalpine fir open forest (O9), moist herb meadow (H16)
EG4	Blanket & veneer over inclined, hummocky & ridged bedrock	Till B (noncalcareous, medium textured)	Dystric Brunisol > Sombric Brunisol, Ferro-Humic Podzol	Heath tundra (L5) > Engelmann spruce - subalpine fir open forest (O10)

EG occurs in association with Miette Group strata in the Main Ranges, and with noncalcareous Mesozoic strata in the Front Ranges. Surficial veneers of Eolian material B

Fig 17 Landscape schematic of the Egypt (EG) Ecosites in relation to other Ecosites.



(altered, medium textured) occur extensively in western Banff and southwestern Jasper. The subdominant and accessory Podzolic soils are associated with these veneers. Slopes range from 15 to 70% for EG1 and EG4, and from 5 to 45% for EG2 and EG3. Soils are well to moderately well drained except for the wet depressional segments of EG3 which are imperfectly to poorly drained. Occurrences of subalpine larch-subalpine fir forest are restricted to southern Banff.

A few EG3 tracts occur on landforms dominated by Till A (noncalcareous, coarse textured). Depressional segments of some EG3 tracts consist of Fluvial material A (noncalcareous, coarse-stratified). Lithic soil phases are important on EG3 and EG4; turbic soil phases on EG4.

WILDLIFE

EG is moderately important to wildlife. The mosaic of habitats often supports a wide variety of small mammal species, but the deep snow precludes much use by ungulates and carnivores in winter.

Table 48. Wildlife features of the EG Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
EG1	medium	moose elk	high	coyote	medium	muskrat snowshoe hare golden-mantled ground squirrel red-backed vole porcupine	low
EG2	high	elk moose	high	marten	medium	heather vole	low
EG3	low	moose	medium	marten	medium	northern bog lemming	medium
EG4	low	caribou	low		low	heather vole	medium

MANAGEMENT CONSIDERATIONS

On EG1, steepness of slope is a major factor to consider in planning park uses. Locally occurring avalanche paths and, less often, seeps will affect certain uses. EG2 is similar to EG1 in its management concerns but is of limited areal extent. Eolian material B veneers are common on EG2 and tend to erode easily where vegetation is removed. Dry portions of EG3 have no limitations other than those mentioned above. However, the dry > wet landscape pattern requires special consideration in location and design when planning some uses, e.g. trail construction. EG4 is similar to EG1 in its management concerns but its heath tundra vegetation is slow to recover from disturbances.

EN - ENDLESS CHAIN

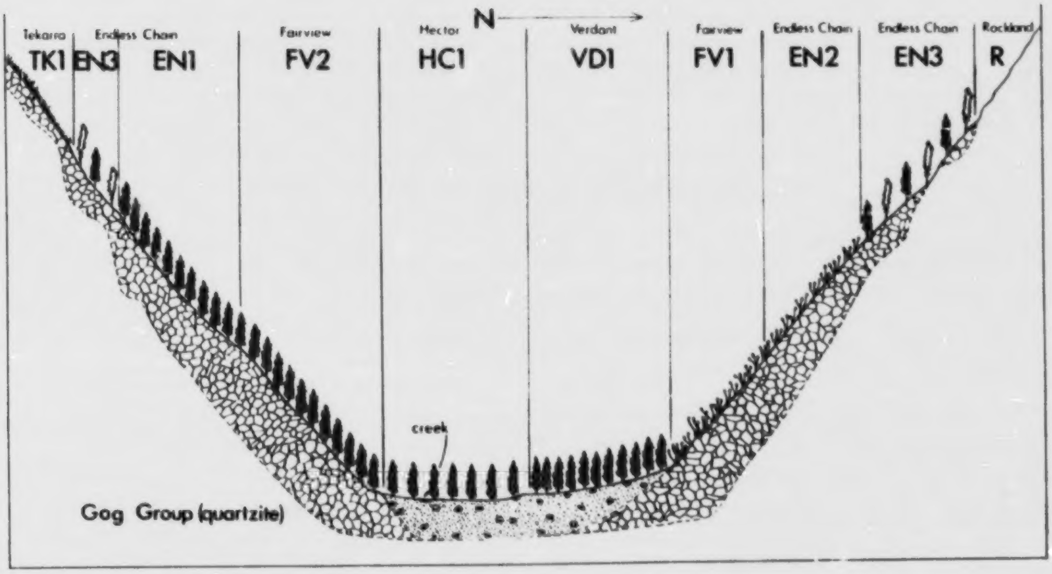
The Endless Chain (EN) Ecosection encompasses inclined landforms of noncalcareous, coarse textured colluvium in the Upper Subalpine portion of the Subalpine Ecoregion. It is dominated by Dystric Brunisols occurring under Engelmann spruce-subalpine fir closed and open forest, mixed coniferous open forest, and an avalanche complex of v.t.s. Vegetational differences are the main criteria separating the three EN Ecosites (Table 49). Landscape positions are shown in Fig. 18.

EN occurs primarily in the Main Ranges on or below steep, rocky, valley walls in areas dominated by Gog Group strata. Surficial veneers of Eolian material B (altered, medium textured) occur sporadically. Slopes commonly range from 45 to 100%. Soils are rapidly to well drained. Avalanche paths characteristically occupy more than 50% of EN2. Unvegetated portions may constitute up to 50% of EN2 and EN3 tracts. EN3 is the steepest of three EN Ecosites and has the greatest abundance of lithic soils and rock outcrops. Avalanche Complex 2, for EN2, is a heterogeneous complex of v.t.s. that includes subalpine fir-willow (S2), willow-dwarf birch-shrubby cinquefoil (S10), juniper-willow (L2), hairy wild rye - wild strawberry -fireweed (H5), fleabane-valerian (H16), plus intergrades, with S2 being most abundant.

Table 49. General features of the EN Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
EN1	Blanket & veneer over inclined bedrock	Collovium A (noncalcareous, coarse textured)	Dystric Brunisol	Engelmann spruce - subalpine fir closed & open forest (C15, C21, O10)
EN2	Blanket & veneer over inclined bedrock, apron	Colluvium A (noncalcareous, coarse textured)	Dystric Brunisol > Regosol	Avalanche Complex 2 > mixed coniferous open forest (O4) > Engelmann spruce subalpine fir open forest (O10)
EN3	Blanket & veneer over inclined bedrock > inclined bedrock	Colluvium A (noncalcareous, coarse textured)	Dystric Brunisol > Regosol	Mixed coniferous open forest (O4) > Engelmann spruce - subalpine fir open forest (O10)

Fig. 18 Landscape schematic of the Endless Chain Ecosites in relation to other Ecosites.


N →
Tekarra
TK1
Endless Chain
EN3
EN1
Fairview
FV2
Hector
HC1
Verdant
VD1
Fairview
FV1
Endless Chain
EN2
Endless Chain
EN3
Rockland
R
creek
Gog Group (quartzite)

WILDLIFE

Table 50. Wildlife features of the EN Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
EN1	medium	mountain goat	low		medium		low
EN2	medium	mountain goat	low		medium	meadow vole western jumping mouse	low
EN3	medium	deer elk	low	wolf coyote	low	snowshoe hare	low

This steep Ecosection is of low importance to wildlife, although EN1 and EN2 are highly important to goats.

MANAGEMENT CONSIDERATIONS

Steep and locally unstable (colluviating) slopes are limiting factors to be considered for many park uses. Stony surfaces, shallow soils, and bedrock outcrops affect planning for uses such as trails, especially on EN3. Snow avalanching, whether local (on EN1, EN3) or extensive (EN2), will affect winter uses. EN1 is of limited areal extent. Vegetation on EN3 is expected to recover slowly from disturbances.

FR - FIRESIDE ECOSECTION

The Fireside (FR) Ecosection (Table 51) consists of fluvial landforms dominated by Brunisolic soils and lodgepole pine forest within the Montane Ecoregion. The FR Ecosection occurs primarily on lower slopes and floors of valleys.

Table 51. General features of the FR1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
FR1	Fan & apron	Fluvial material B, (calcareous, coarse-stratified)	Eutric Brunisol	Lodgepole pine forest (C6, C19)

FR1 includes landforms comprised of Fluvial material A (noncalcareous, coarse-stratified) in the Miette River valley in Jasper. Surfaces are often channeled. Slopes range from 2 to 30%. Soils are well drained. Regosolic soils occur in narrow strips along present and recently abandoned stream channels. Lodgepole pine/dwarf bilberry (C9) is common on FR1 tracts located in southern Banff.

WILDLIFE

Table 52. Wildlife features of the FR1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
FR1	high	deer elk moose	high	coyote wolf cougar lynx	high	snowshoe hare red squirrel beaver deer mice red-backed vole heather vole	high

FR1 is highly important to wildlife. Many species occur here in large numbers. Ungulates are most abundant in winter. The lush ground cover also supports many species of small mammals and breeding birds.

MANAGEMENT CONSIDERATIONS

FR1 tracts with gentle slopes generally have no characteristics limiting uses for campgrounds, trails, or other related park uses. Locally occurring coarse textures and high water tables may present problems for sewage disposal. Coarse textured materials provide gravel for construction purposes.

EACH TRACT SHOULD BE EVALUATED FOR SPECIFIC PROPOSED USES.

FV - FAIRVIEW ECOSECTION

The Fairview (FV) Ecosection encompasses inclined landforms composed of noncalcareous, colluvial materials in the Lower Subalpine portion of the Subalpine Ecoregion. It is dominated by Dystric Brunisols occurring under Engelmann spruce-subalpine fir forest and an avalanche complex of v.t.s. Table 53 outlines two FV Ecosites separated by vegetational differences. Landscape positions are shown in Fig. 18.

FV occurs primarily in the Main Ranges on or below steep valley walls and is associated with noncalcareous bedrock. Surface veneers of Eolian material B (altered, medium textured) occur sporadically. Slopes commonly range from 45 to 90%. Soils are rapidly to moderately well drained. Snow avalanch paths characteristically occupy more than 50% of FV1. Unvegetated portions may constitute up to 50% of FV1 tracts. Avalanche Complex 1, for FV 1, is a heterogeneous complex of v.t.s. that includes subalpine fir-willow (S2), willow-dwarf birch-shrubby cinquefoil (S10), hairy wild rye - wild strawberry - fireweed (H5), aspen / hairy wild rye - showy aster (C22), plus intergrades, with S2 being most abundant.

Table 53. General features of the FV Ecosites.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
FV1	Blanket & veneer over inclined bedrock, apron	Colluvium A (noncalcareous, coarse textured + Colluvium B (noncalcareous, medium textured)	Dystric Brunisol > Regosol	Avalanche Complex 1 > Engelmann spruce - subalpine fir forest (C13, C14)
FV2	Blanket over inclined bedrock, apron	Colluvium A (noncalcareous, coarse textured) + Colluvium B (noncalcareous, medium textured)	Dystric Brunisol	Engelmann spruce-subalpine fir forest (C13, C14, C21)

WILDLIFE

Table 54. Wildlife features of the FV Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
FV1	low		medium	weasel wolverine	medium	masked shrew pika golden-mantled ground squirrel western jumping mouse	high
FV2	medium		low		medium	red-backed vole	medium

FV is moderately important to wildlife, especially small mammals and birds.

MANAGEMENT CONSIDERATIONS

Steep and locally unstable (colluviating) slopes are limiting factors to be considered for many park uses. Stony surfaces will affect planning for uses such as trails. Snow avalanching, whether local (on FV2) or extensive (FV1), will affect winter uses.

GA - GARONNE ECOSECTION

The Garonne (GA) Ecosection encompasses hummocky landslide deposits in the Montane Ecoregion. It is dominated by Brunisolic and Regosolic soils and lodgepole pine forest. The general features of the GA1 Ecosite are outlined in Table 55.

Table 55. General features of the GA1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
GA1	Hummocky	Landlside material (calcareous, medium textured)	Eutric Brunisol, Regosol	Lodgepole pine forest (C3, C6, C19)

Surficial veneers of Eolian material A (calcareous, medium textured) overlie the landslide material in Jasper and veneers of Eolian material B (altered, medium textured) overlie landslide material in Banff. Complex slopes range from 15 to 45%. Soils are rapidly to well drained. Rubbly, blocky surfaces occur locally.

WILDLIFE

Table 56. Wildlife features of the GA1 Ecosite

	Ungulates		**Carnivores**		**Small Mammals**		**Birds**
Ecosite	**Ranking**	**Important Species**	**Ranking**	**Important Species**	**Ranking**	**Important Species**	
GA1	**high**	**deer** **elk**	**high**	**wolf** **coyote** **cougar**	**medium**		**high**

GA is highly important to wildlife. The varied topography, vegetation and low elevation contribute to its importance to many species of ungulates, carnivores and birds.

MANAGEMENT CONSIDERATIONS

GA1 is of very limited areal extent. Irregular topography, often with moderate to steep slopes, and sites with rubbly, blocky surfaces are limiting for park uses such as campgrounds and may affect the design of trails and roads.

GT - GOAT ECOSECTION

The Goat (GT) Ecosection encompasses calcareous, morainal landforms dominated by a Brunisolic > Regosolic soil pattern within the Lower Subalpine portion of the Subalpine Ecoregion. Vegetation is characterized by lodgepole pine forest, white spruce open forest, mixed coniferous open forest, dry grassland, and low shrub-herb meadow. Table 57 outlines two GT Ecosites differentiated by patterns of soils and vegetation. Landscape positions are shown in Figs. 19 and 29.

Table 57. General features of the GT Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
GT1	Blanket over inclined bedrock	Till C (calcareous, medium textured)	Eutric Brunisol > Regosol	Lodgepole pine forest (C3), mixed coniferous open forest (O4), white spruce open forest (O17)
GT2	Blanket over inclined & ridged bedrock, inclined	Till C (calcareous, medium textured)	Northerly: Eutric Brunisol Southerly: Eutric Brunisol, Humic Regosol	Lodgepole pine forest (C6, C19) Dry grassland (H14), low shrub-herb meadow (L1)

GT1 occurs on valley walls primarily with southerly aspects. Soil and vegetation patterns reflect surface erosional processes including gullying, sheet erosion, and soil creep. Slopes range from 45 to 70%. Soils are rapidly to well drained. GT2 occurs in the Front Ranges, usually in association with Mesozoic strata. Surface expression reflects stream incisions on valley floors and bedrock control on valley walls and benchlands. Some GT2 tracts on river banks include Ice Contact Stratified Drift B (calcareous, variably textured). Slopes range from 30 to 90%. GT2 soils and vegetation are distributed in a pattern governed by aspect, steepness of slope, exposure, and erosional processes. Stable positions of the landscape, collectively labelled "northerly aspect" segments, are dominated by well drained Brunisolic soils under lodgepole pine forest. Eroding or recently eroded portions of the landscape, collectively labelled "southerly aspect" segments, have rapidly drained Brunisolic and Regosolic soils under grassland and shrub-herb meadow vegetation.

WILDLIFE

GT is very important to wildlife except birds. Dry, southerly, exposed slopes with grasslands are important foraging areas for ungulates and small mammals. Carnivores are attracted here by the abundant prey.

Fig. 19 Landscape schematic of the Goat Ecosites in relation to other Ecosites.

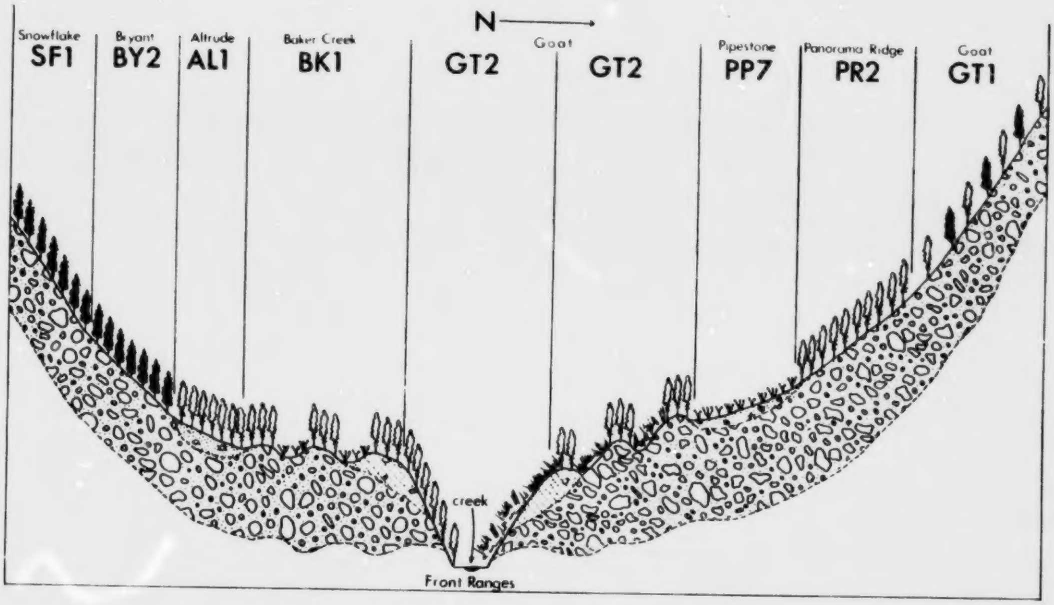

N
Snowflake
SF1
Bryant
BY2
Altrude
AL1
Baker Creek
BK1
GT2
Goat
GT2
Pipestone
PP7
Panorama Ridge
PR2
Goat
GT1
creek
Front Ranges

Table 58. Wildlife features of the GT Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
GT1	high	elk bighorn sheep mountain goat deer	very high	cougar wolf coyote	medium	masked shrew heather vole	low
GT2	very high	elk deer mountain goat	very high	wolf coyote cougar lynx	very high	snowshoe hare least chipmunk columbian ground squirrel deer mice northern bog lemming meadow vole	medium

MANAGEMENT CONSIDERATIONS

Steep and locally eroding slopes are limiting factors to be considered for many park uses of GT1 and GT2. On GT2 tracts, moderately sloping, forested portions are not limiting for trails and related park uses, but removal of vegetation on nonforested portions would increase erosion significantly. Nonforest vegetation is likely to recover slowly from disturbances.

HC - HECTOR ECOSECTION

The Hector (HC) Ecosection encompasses wet fluvial and fluviolacustrine landforms on valley floors in the Lower Subalpine portion of the Subalpine Ecoregion. A complex set of genetically related Gleysolic, Gleyed Regosolic, and Organic soils occur. Various groupings of Engelmann spruce forest, Engelmann spruce - subalpine fir open forest, wet shrubby meadow, birch fen, wet shrub thicket, and sedge fen differentiate the three HC Ecosites outlined in Table 59. Landscape positions are shown in Figs. 11, 15, 18, and 29.

Table 59. General features of the HC Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
HC1	Level, apron, fan > horizontal fen	Fluvial material A & B (noncalcareous & calcareous, coarse-stratified) > fen peat	Gleysol > gleyed Regosolic, Mesisol	Moist Engelmann spruce forest (C32), wet Engelmann spruce-subalpine fir open forest (O6) > wet shrubby meadow (S1), birch fen (S3)
HC2	Level	Fluviolacustrine material B (calcareous,fine-stratified)	Gleysol	Sedge fen (H11)
HC4	Level, apron, fan > horizontal fen	Fluvial materials A & B (noncalcareous & calcareous, coarse-stratified) > fen peat	Gleysol > gleyed Regoslic, Mesisol	Wet shrubby meadow (S1), birch fen (S3), wet shrub thicket (S11), sedge fen (H11)

Wetness on HC results from high water tables, seepage, and groundwater discharge and gives imperfectly to very poorly drained soils. Fluviolacustrine deposits are important accessory materials on HC1 and HC4. Soils in active or recently active sedimentation environments lack surface peat layers, whereas soils of geomorphically inactive localities have surface organic layers and include Mesisols on horizontal fens in ponded localities. Active siltation from ponded, glacial streams characterizes most HC2 tracts, hence surface peat layers are absent and a bryoid-poor variant of the H11 v.t. is dominant. Slopes are often channeled and range from 0 to 9% on HC1 and HC4, 0 to 1% on HC2.

WILDLIFE

Table 60. Wildlife features of the HC Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
HC1	medium	moose	high	wolverine wolf coyote	medium	masked shrew dusky shrew western jumping mouse	high
HC2	low		medium	weasel	low	beavers northern bog lemming meadow vole porcupine	high
HC4	high	moose elk caribou	high	weasel cougar wolf coyote	medium		high

HC is highly important to wildlife, especially birds. Ecosites with open or no forest cover are the most important. The shrub and sedge meadows are highly important moose habitat. The willow meadows are critical winter habitat for White-tailed Ptarmigan.

MANAGEMENT CONSIDERATIONS

Imperfect to very poor drainage, resulting from high water tables and local flooding, severely limits most park uses unless expensive construction techniques are followed. On some tracts, particularly on the very poorly drained HC2 Ecosites, sediment deposition accompanies flooding. Major construction activities (e.g. roads) will change sedimentation and erosional patterns. HC2 is of limited areal extent.

EACH TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

HD - HILLSDALE ECOSECTION

The Hillsdale Ecosection encompasses fluvial landforms dominated by Regosolic soils in the Montane Ecoregion. Various vegetational groupings involving aspen, white spruce, lodgepole pine, and white spruce-Douglas fir forests and grassland differentiate the four HD Ecosites outlined in Table 61.

HD occurs on lower slopes and valley floors. Channeled surfaces are common. Surficial veneers of Eolian material A (calcareous, medium textured) occur north of Jasper Lake . Tracts mapped in the Miette River valley in Jasper are comprised of Fluvial material A (noncalcareous, coarse-stratified). Slopes range from 1 to 15%. Soils are rapidly to moderately well drained; gleyed soils with imperfect drainage occur on the

Table 61 General features of the HD Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
HD1	Fan, apron	Fluvial material B (calcareous, coarse-stratified)	Regosol	Aspen forest (C16)
HD2	Fan, level, apron	Fluvial material B (calcareous, coarse-stratified)	Regosol	Spruce open forest (O3)
HD3	Fan, apron	Fluvial material B (calcareous, coarse-stratified)	Regosol	White spruce forest (C2, C26, C27), white spruce-Douglas fir forest (C5)
HD4	Fan, apron	Fluvial material B (calcareous, coarse-stratified)	Regosol	Grassland (H6) + lodgepole pine forest (C3)

toes of fans and aprons.

WILDLIFE

This Montane Ecosection is very important to wildlife. Critical range for elk and deer occurs here. High densities of small mammals, birds and some carnivores were recorded on all Ecosites. HD has low snow accumulation and palatable forage which contribute to its importance to ungulates.

MANAGEMENT CONSIDERATIONS

Fluvial deposition is sufficiently frequent to maintain the dominantly Regosolic soils and is a major factor to consider in planning of park uses. Locally occurring coarse textures and high water tables present problems for sewage disposal. The coarse textured material provides gravel for construction purposes. HD4 is of limited areal extent. It is also particularly droughty and problems in revegetation are likely to occur.

EACH TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

HE - HEATHER ECOSECTION

The Heather (HE) Ecosection encompasses residual and bedrock landforms in the Alpine Ecoregion. Lithic phases of Brunisolic and Regosolic soils dominate areas where soil is present, but areas of nonsoil (surface veneers <10 cm thick over bedrock) are common. Mountain avens tundra dominates most HE tracts. Table 63 outlines the features of the two HE Ecosites differentiated by consolidated versus unconsolidated bedrock and resultant effects on soil and vegetation.

HE occurs at high elevations on cols, plateaus, rounded mountain peaks and ridges, and

Table 62 Wildlife features of the HD Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
HD1	high	elk deer	high	coyote cougar marten wolf	high	columbian ground squirrel red squirrel meadow vole	high
HD2	very high	elk deer	high	wolf coyote lynx cougar	very high	masked shrew snowshoe hare red squirrel deer mice	high
HD3	high	deer moose	high	wolf coyote cougar lynx	high	snowshoe hare least chipmunk deer mice	high
HD4	very high	elk deer bighorn sheep	high	wolf cougar	high	red squirrel deer mice	high

Table 63 General features of the HE Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
HE1	Inclined, hummocky, ridged	Residuum A & B (noncalcareous + calcareous, medium textured)	Sombric + Melanic Brunisol, Humic Regosol (lithic phases)	Mountain avens tundra (H1)
HE2	Ridged bedrock > veneer over ridged + hummocky, bedrock	Calcareous bedrock > Residuum B (calcareous, medium textured)	Nonsoil >> Melanic Brunisol, Humic Regosol (lithic phases)	Unvegetated portions > mountain avens tundra (H1)

in cirques. HE1 occurs most often on Miette strata in the Main Ranges and Mesozoic strata in the Front Ranges; HE2 usually occurs on resistant carbonate strata in the Main Ranges. Slopes range up to 45% on HE1 and from 5 to 70% on HE2. Solifluction with turbic soil phases is common on HE1. Bedrock is the dominant feature of HE2 and vegetation is more extensive than soil.

WILDLIFE

Table 64. Wildlife features of the HE Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
HE1	medium	bighorn sheep mountain goat	low	weasel	medium	pika columbian ground squirrel golden-mantled ground squirrel	low
HE2	medium	bighorn sheep mountain goat	low		low	golden-mantled ground squirrel	low

HE is of low importance to all wildlife except sheep and goat which forage here intensively.

MANAGEMENT CONSIDERATIONS

Bedrock and shallow soils are major considerations in planning park uses of the HE Ecosection. Solifluction and cryoturbation are common on some HE1 tracts. Vegetation is expected to recover slowly from disturbances. HE2 is of slightly different concern than HE1, especially since rockiness is the salient feature and excludes those uses requiring unconsolidated materials, e.g. in trail building. Vegetation on HE2 is expected to recover very slowly from disturbances. Wet sites make up only a small portion of HE2 but are lushly vegetated and conspicuous. It is expected that these small wet sites can be easily damaged.

IB - ISHBEL ECOSECTION

The Ishbel (IB) Ecosection encompasses hummocky landslide deposits in the Lower Subalpine portion of the Subalpine Ecoregion. Brunisolic and Regosolic soils are associated with lodgepole pine forest, coniferous open forest, and Engelmann spruce-subalpine fir forest. Table 65 outlines the features of three IB Ecosites that are seperated primarily by vegetational differences. Landscape position is shown in Fig. 10.

IB occurs on mid to lower valley wall positions. Surfaces are often stony and bouldery. Veneers of Eolian material B (altered, medium textured) are common on IB1 and IB3 tracts in western Banff and southwestern Jasper. Soils are rapidly to well drained; Eutric Brunisols occur on calcareous materials, Dystric Brunisols on noncalcareous materials. Unvegetated portions may constitute up to 50% of IB2 tracts.

Table 65. General features of the IB Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
IB1	Hummocky	Landslide material (calcareous + noncalcareous, variably textured)	Eutric & Dystric Brunisol	Lodgepole pine forest (C18, C19, C29)
IB2	Hummocky	Landslide material (calcareous & noncalcareous, variably textured)	Regosol, Eutric + Dystric Brunisol	Mixed coniferous open forest (O4), spruce open forest (O17)
IB3	Hummocky	Landslide material (calcareous + noncalcareous, variably textured)	Eutric & Dystric Brunisol	Engelmann spruce - subalpine fir forest (C21, C30)

WILDLIFE

Table 66. Wildlife features of the IB Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
IB1	medium		medium	wolf	high	red-backed vole	medium
IB2	low		medium	wolverine	medium	pika red squirrel	medium
IB3	low	moose	medium	lynx cougar	low	masked shrew snowshoe hare	medium

IB is moderately important to wildlife. The wildlife is typical of much of the subalpine forests.

MANAGEMENT CONSIDERATIONS

Irregular topography, often with moderate to steep slopes, and sites with rubbly, blocky surfaces are limiting for campgrounds and related uses and can affect the design of trails and roads. Vegetation on IB2 is expected to recover slowly from disturbances, including fire.

JN - JONAS ECOSECTION

The Jonas (JN) Ecosection encompasses morainal landforms consisting of noncalcareous, medium textured till in the Alpine Ecoregion. A soil pattern of Dystric and Sombric Brunisols and Podzolics occurs under heath and mountain avens tundra. Table 67 summarizes characteristics of the JN1 Ecosite. Landscape position is shown in Fig. 17.

Table 67. General features of the JN1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
JN1	Blanket & veneer over inclined, hummocky, & ridged bedrock	Till B (noncalcareous, medium textured)	Dystric & Sombric Brunisol > Ferro-Humic Podzol	Heath tundra (L5), mountain avens tundra (H1)

JN1 occurs on valley walls and shoulders and in cirque basins and cols. Veneers of Eolian material B (altered, medium textured) occur extensively in western Banff and southwestern Jasper, sporadically elsewhere. Podzolic soil occurrences are associated with these veneers. Slopes range from 5 to 45%. Soils are well to moderately well drained. Solifluction and cryoturbation are common surface modifiers. Lithic and turbic soil phases occur. Heath tundra (L5) vegetation is most abundant.

WILDLIFE

Table 68. Wildlife features of the JN1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
JN1	medium	caribou bighorn sheep mountain goat	low		low	pika hoary marmot columbian ground squirrel golden-mantled ground squirrel	low

JN1 is of low importance to wildlife except some ungulates and small mammals. Sheep and goat occur in high numbers.

MANAGEMENT CONSIDERATIONS

An intricate pattern of soils and vegetation, related to drainage conditions, necessitates detailed evaluation of individual tracts for planning of park uses. Of particular concern are imperfectly to poorly drained and soliflucted sites. Vegetation is expected to recover slowly from disturbances.

KA - KATHERINE ECOSECTION

The Katherine (KA) Ecosection (Table 69) encompasses fluvial apron and fan landforms in the Alpine Ecoregion. Regosolic and Gleysolic soils occur under dwarf shrub-herb meadow and mountain avens tundra. Landscape position is shown in Fig. 20.

Table 69. General features of the KA1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
KA1	Fan, apron	Fluvial materials A & B (noncalcareous & calcareous, coarse-stratified)	Humic Regosol, Gleysol	Dwarf shrub-herb meadow (L7), mountain avens tundra (H1)

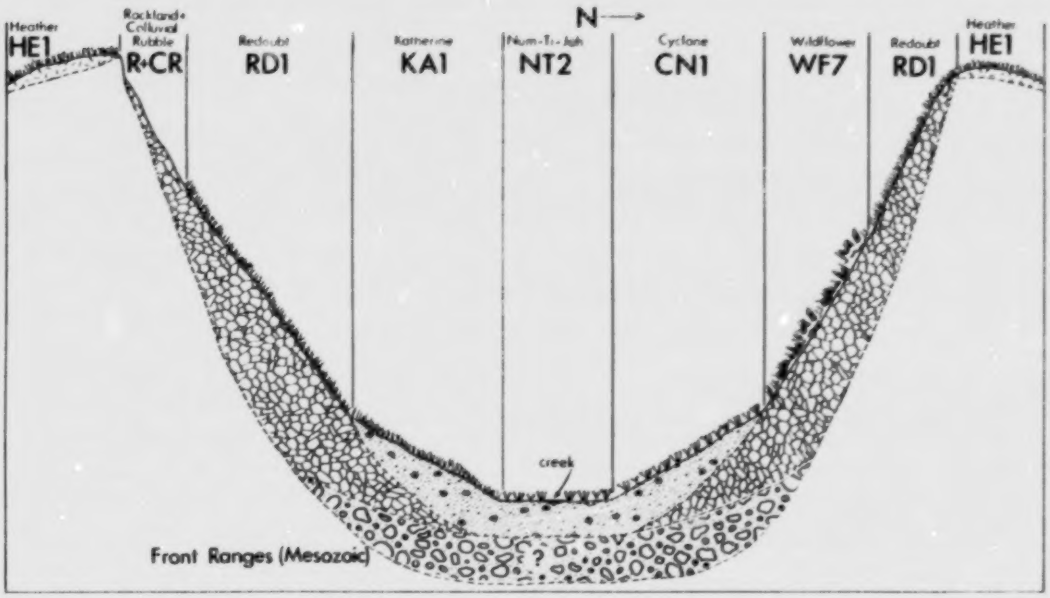
KA is most extensive in the Front Ranges and occurs on lower valley wall slopes and valley floors. Variable seepage conditions related to snow melt and soil thaw on slopes above KA maintain its moist to wet conditions (i.e. moderately well to poorly drained soils). Stratified deposits, including interbedded and mixed humus, are manifestations of episodic fluvial deposition and mixing by solifluction. Slopes range from 1 to 30% and are often channeled and soliflucted.

WILDLIFE

Table 70. Wildlife features of the KA1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
KA1	high	bighorn sheep moose elk	low		low		low

Fig. 20 Landscape schematic of the Katherine 1 (KA1) Ecosite in relation to other Ecosites.


N →
Heather
HE1
Rockland+
Colluvial
Rubble
R+CR
Redoubt
RD1
Katherine
KA1
Num-Ti-Jah
NT2
Cyclone
CN1
Wildflower
WF7
Redoubt
RD1
Heather
HE1
creek
Front Ranges (Mesozoic)
?

KA1 is of low importance to wildlife overall, but highly important to sheep, moose and elk in summer. The wet alpine meadows provide summer forage for these ungulates.

MANAGEMENT CONSIDERATIONS

An intricate pattern of soils and vegetation, related to drainage and solifluction, necessitates detailed evaluation of individual tracts for trails, campgrounds, or other park uses. Of particular concern are imperfectly to poorly drained and soliflucted localities. The soils lack B horizons, suggesting that geomorphic activity or wetness are sufficiently great to maintain these weakly developed soils. Vegetation is expected to recover slowly from disturbances.

LV - LARCH VALLEY ECOSECTION

The Larch Valley (LV) Ecosection encompasses morainal landforms comprised of noncalcareous, coarse textured till in the Upper Subalpine portion of the Subalpine Ecoregion. A Brunisolic > Podzolic soil complex dominates and occurs under subalpine larch-subalpine fir forest, Engelmann spruce-subalpine fir closed and open forest, and a distinctive pattern of heath tundra plus coniferous open forest. These vegetational differences separate the three LV Ecosites (Table 71). Landscape positions are shown in Fig. 21.

Table 71. General features of the LV Ecosite

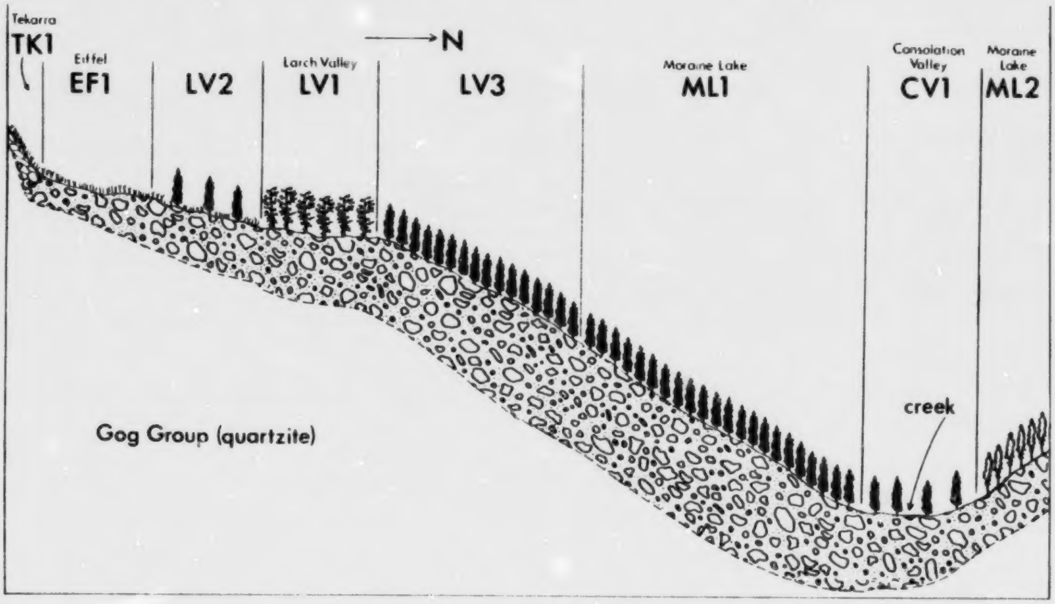
Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
LV1	Blanket over inclined, hummocky & ridged bedrock	Till A (noncalcareous, coarse textured)	Dystric Brunisol > Humo-Ferric Podzol	Subalpine larch - subalpine fir forest (C23)
LV2	Blanket, veneer over inclined, hummocky & ridged bedrock	Till A (noncalcareous, coarse textured)	Dystric Brunisol > Sombric Brunisol, Ferro-Humic Podzol	Heath tundra (L5) > Engelmann spruce - subalpine fir open forest (O10)
LV3	Blanket over inclined bedrock	Till A (noncalcareous, coarse textured)	Dystric Brunisol > Humo-Ferric Podzol	Engelmann spruce - subalpine fir closed and open forest (C15, C21, O10)

Table 72. Wildlife features of the LV Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
LV1	low	moose	low	wolf	medium	least chipmunk heather vole long-tailed vole western jumping mouse	low
LV2	low		low	weasel	medium	hoary marmots columbian ground squirrel heather vole porcupine	low
LV3	medium	mountain goat caribou	medium	marten wolverine	low	dusky shrew pika columbian ground squirrel heather vole porcupine	medium

LV occurs primarily on valley walls and shoulders, cirque basins, and cols. It occurs in the Main Ranges in areas dominated by Gog Group quartzites. Veneers of Eolian material B (altered, medium textured) occur extensively in western Banff and southwestern Jasper; the subdominant Podzolic soils are associated with these veneers. Slopes range from 15 to 70%; soils are well drained. Occurrences of subalpine larch-subalpine fir forest (C23) are restricted to southern Banff. Lithic soil phases are important on tracts mapped as LV2.

Fig. 21 Landscape schematic of the Larch Valley (LV) Ecosites in relation to other Ecosites.


Tekarra
TK1
Eiffel
EF1
LV2
Larch Valley
LV1
→ N
LV3
Moraine Lake
ML1
Consolation Valley
CV1
Moraine Lake
ML2
creek
Gog Group (quartzite)

WILDLIFE

LV is moderately important to wildlife, particularly small mammals which occur in high numbers here. LV3 is also important to goat and caribou in the summer.

MANAGEMENT CONSIDERATIONS

All three of the LV Ecosites have similar management concerns, except that LV1 is of limited areal extent. Steepness of slope is the major factor in planning park uses, but coarse textures may also influence certain uses. The eolian veneers, common in many areas, tend to erode easily where vegetation is removed. Locally occurring avalanche paths will affect certain uses. Heath tundra vegetation on LV2 is slow to recover from disturbances.

MC - MERLIN CASTLE ECOSECTION

The Merlin Castle (MC) Ecosection encompasses a wet > dry landscape pattern on glaciolacustrine landforms in the Lower Subalpine portion of the Subalpine Ecoregion. Wet (poorly drained) segments are dominated by Gleysolic and gleyed Brunisolic soils under wet spruce open forest and birch fen. Dry (well to moderately well drained) segments are dominated by Luvisolic and Brunisolic soils under lodgepole pine and Engelmann spruce-subalpine fir forests. Table 73 outlines the features of the MC1 Ecosite.

MC1 occupies valley floor benchland positions. Wetness is attributed to seepage and surface water accumulation. Veneers of fen peat, Fluviolacustrine material A (altered, fine-stratified), and Eolian material B (altered, medium textured) occur locally. Slopes range from 0 to 10%.

WILDLIFE

MC1 is of low importance to wildlife.

MANAGEMENT CONSIDERATIONS

Poor drainage, resulting from surface water collection on slowly pervious, fine textured, glaciolacustrine material, severely limits most park uses unless expensive construction techniques are followed.

Table 73. General features of the MC1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
MC1	Glaciolacustrine veneer & blanket over ridged, hummocky, & undulating glacial materials	Glaciolacustrine material (calcareous, fine textured) over Ice contact stratified Drift A & B (non-calcareous, coarse textured & calcareous, variably textured)	Wet 80: Gleysol, Gleyed Eutric Brunisol Dry 20: Gray Luvisol, Eutric Brunisol	Spruce open forest (O11), birch fen (S3) Lodgepole pine forest (C29) Engelmann spruce-subalpine fir forest (C30)

Table 74. Wildlife features of the MC1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
MC1	low	moose	medium		low		low

ML - MORAINE LAKE ECOSECTION

The Moraine Lake (ML) Ecosection encompasses morainal landforms comprised of noncalcareous, coarse textured till in the Lower Subalpine portion of the Subalpine Ecoregion. Dystric Brunisols are the dominant soils. Vegetation is dominated by Engelmann spruce-subalpine fir forest, lodgepole pine forest, and Engelmann spruce-whitebark pine forest. Table 75 summarizes three ML Ecosites distinguished by vegetational differences. Landscape position is shown in Fig. 21.

Table 75. General features of the ML Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
ML1	Blanket over inclined bedrock	Till A (noncalcareous, coarse textured)	Dystric Brunisol > Humo-Ferric Podzol	Engelmann spruce - subalpine fir forest (C13, C14, C21)
ML2	Blanket over inclined bedrock	Till A (noncalcareous, coarse textured)	Dystric Brunisol	Lodgepole pine forest (C18, C20)
ML3	Blanket over inclined bedrock	Till A (noncalcareous, coarse textured)	Dystric Brunisol	Engelmann spruce - white bark pine forest (C12)

ML occurs primarily on valley walls in the Main Ranges and is associated with Gog Group quartzites. Veneers of Eolian material B (altered, medium textured) occur extensively in western Banff and southwestern Jasper, sporadically elsewhere. Podzolic soils are associated with the eolian veneers. Slopes range from 15 to 70% and are often gullied; soils are well drained. ML3 occurs only in Jasper.

WILDLIFE

ML is highly important to wildlife, especially small mammals and birds. The moist coniferous forests support a high concentration of many species of small mammals and birds.

MANAGEMENT CONSIDERATIONS

Steepness of slope is the major factor in planning park uses, but coarse textures and high coarse fragment content may also influence certain uses. Eolian material B veneers are extensive on many ML1 tracts and tend to erode easily where vegetation is removed. Locally occurring avalanche paths will affect certain uses. ML3 is of limited areal extent.

Table 76. Wildlife features of the ML Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
ML1	low	moose	medium		very high	pika least chipmunk yellow pine chipmunk golden-mantled ground squirrel red-backed vole heather vole western jumping mouse porcupine	high
ML2	low	moose	low		high	red squirrel deer mouse red-backed vole heather vole	medium
ML3	medium	deer caribou	medium	wolf marten cougar	high	yellow pine chipmunk red squirrel red-backed vole heather vole	high

MP - MOLAR PASS ECOSECTION

The Molar Pass (MP) Ecosection encompasses morainal landforms of calcareous, medium textured till in the Alpine Ecoregion. It is dominated by Brunisolic and Regosolic soils under mountain avens and heath tundra. Table 77 summarizes the MP1 Ecosite and Fig. 25 indicates the landscape position.

Table 77. General features of the MP1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
MP1	Blanket, veneer over inclined, hummocky, & ridged bedrock	Till C (calcareous, medium textured)	Eutric & Melanic Brunisol, Regosol, Humic Regosol	Mountain avens tundra (H1), heath tundra (L5).

MP1 occurs on valley walls, valley shoulders, cirque basins and cols. Veneers of Eolian material B (altered, medium textured) are most extensive on MP1 tracts of western Banff and southwestern Jasper. Slopes range from 5 to 45%. Soils are well to moderately well drained. Lithic and turbic soil phases occur. Solifluction and cryoturbation are common surface modifiers. Mountain avens tundra (H1) is abundant on most tracts.

WILDLIFE

Table 78. Wildlife features of the MP1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
MP1	medium	bighorn sheep mountain goat	low	wolverine	low	pika hoary marmot columbian ground squirrel golden-mantled ground squirrel	low

MP1 is of low importance to most wildlife. It is highly important to sheep, goat and some small mammals, especially in summer.

MANAGEMENT CONSIDERATIONS

An intricate pattern of soils and vegetation, related to geomorphic activity, necessitates detailed evaluation of individual tracts for trails, campgrounds, and related park uses. Of particular concern are soliflucted and cryoturbated localities and sites with imperfect drainage. Vegetation is expected to recover slowly from disturbances.

MQ - MOSQUITO ECOSECTION

The Mosquito (MQ) Ecosection encompasses fluvial fan and apron landforms dominated by Brunisolic and Regosolic soils and Engelmann spruce-subalpine fir open and closed forests in the Upper Subalpine portion of the Subalpine Ecoregion. It occurs on lower slopes and valley floors. Table 79 outlines features of the MQ1 Ecosite.

Table 79. General features of the MQ1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
MQ1	Fan, apron	Fluvial material B (calcareous, coarse-stratified)	Eutric Brunisol, Regosol	Engelmann spruce - subalpine fir closed and open forest (C15, O10)

Fluvial material A (noncalcareous, coarse stratified) occurs on some tracts. Veneers of Eolian material B (altered, medium textured) occur occasionally. Slopes range from 5 to

45% and are often channeled. Soils are well to moderately well drained.

WILDLIFE

Table 80. Wildlife features of the MQ1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
MQ1	high	deer moose elk	very high	wolf marten wolverine coyote cougar	medium	snowshoe hare columbian ground squirrel red squirrel	high

MQ1 is highly important to wildlife. The alluvial landforms are vegetated with a well developed shrub layer beneath the spruce-fir forest canopy which is forage for ungulates and cover for breeding birds. Deep snow limits large mammal activity in winter.

MANAGEMENT CONSIDERATIONS

Gently sloping MQ1 tracts dominated by Brunisolic soils generally have no limits for campgrounds, trails, or related park uses. However, Regosolic soils dominate some tracts where fluvial deposition is sufficiently frequent to maintain these weakly developed soils. This is the major factor in planning of certain park uses. Locally occurring coarse textures and high water tables present problems for sewage disposal. The coarse textured material provides gravel for construction purposes. The high content of coarse fragments may cause problems for some uses, e.g. trails, campgrounds, or playgrounds. Several tracts are locally avalanched, a factor to be considered for some uses.

EACH TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

NG - NIGEL ECOSECTION

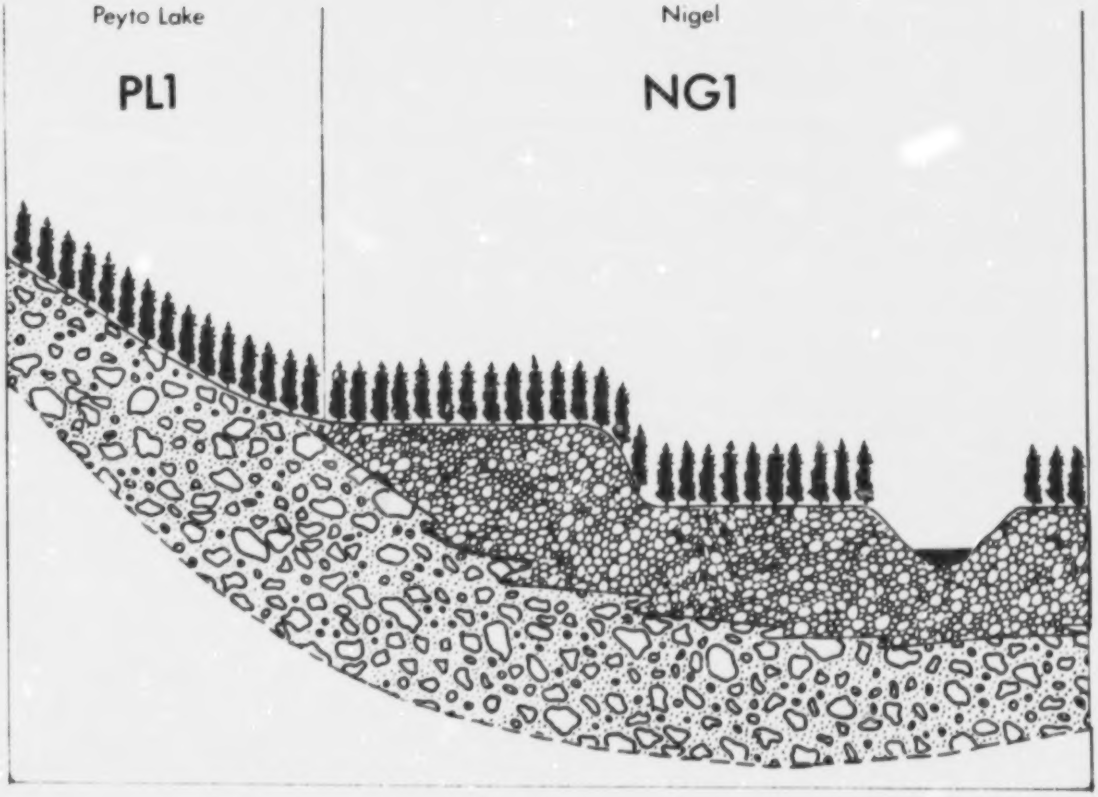
The Nigel (NG) Ecosection encompasses terraced landforms of calcareous glaciofluvial material in the Upper Subalpine portion of the Subalpine Ecoregion. It is dominated by soils under Engelmann spruce-subalpine fir closed and open forest. Table 81 outlines the features of the NG1 Ecosite. Landscape position is shown in Fig. 22.

Only two NG1 tracts were mapped, both in Banff. Thin veneers of Eolian material B (altered, medium textured) occur. Soils are well drained. NG1 occurs on valley floors. Slopes range from 1 to 15%.

Table 81. General features of the NG1 Ecosite.

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
NG1	Terraced	Glaciofluvial material B (calcareous, coarse textured)	Eutric Brunisol	Engelmann spruce - subalpine fir closed and open forest (C15, O10)

Fig. 22 Landscape schematic of the Nigel 1 (NG1) Ecosite.



WILDLIFE

NG1 is of low importance to wildlife except birds.

Table 82. Wildlife features of the NG1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
NG1	low		low		low		high

MANAGEMENT CONSIDERATIONS

NG1 is of very limited areal extent. Level topography and valley floor positions are conducive to many uses. Coarse textures provide gravel supplies. Coarse textured material is ineffective as an ion filter, a factor to be considered in sewage disposal system design. The coarse textures also promote droughtiness and problems in revegetation are likely to occur. The high content of coarse fragments may affect some uses, e.g. trails or campgrounds.

NH - NASHAN ECOSECTION

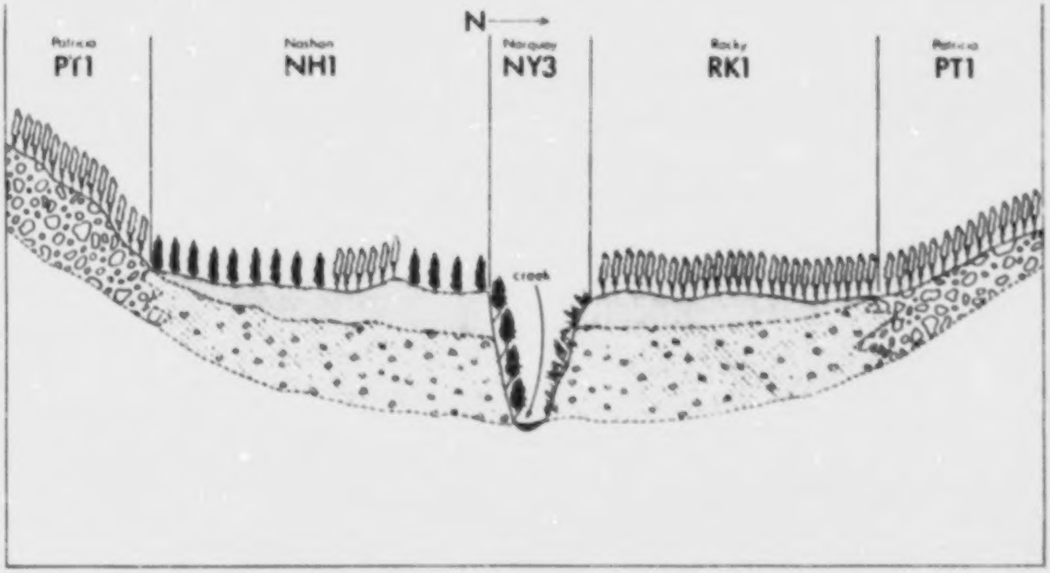
The Nashan (NH) Ecosection encompasses a wet > dry landscape pattern on glaciolacustrine landforms in the Montane Ecoregion. Wet (poorly drained) segments are dominated by Gleysolic soils under spruce open forest. Dry (well to moderately well drained) segments are dominated by Luvisolic and Brunisolic soils under lodgepole pine forest. Table 83 outlines the features of the NH1 Ecosite. Landscape position is shown in Fig. 23.

Table 83. General features of the NH1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
NH1	Glaciolacustrine blanket over undulating & hummocky glacial materials	Glaciolacustrine material (calcareous, fine textured)	Wet 80: Gleysol Dry 20: Gray Luvisol > Brunisol	Spruce open forest (O11) Lodgepole pine forest (C19, C29)

The glaciolacustrine material overlies Ice Contact Stratified Drift B (calcareous, variably textured). Wet segments usually have thin organic veneers of fen peat and veneers of Fluviolacustrine material A (altered, fine stratified). Dry segments have thin, discontinuous veneers of Eolian material B (altered, medium textured). Complex slopes range from 0 to 10%. NH1 occurs only in Jasper.

Fig. 23 Landscape schematic of the Nashan 1 (NH1) Ecosite in relation to other Ecosites.


N
Patricia
PT1
Nashan
NH1
Narquay
NY3
Rocky
RK1
Patricia
PT1
creek

WILDLIFE

Table 84. Wildlife features of the NH1 Ecosite

	Urgulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
NH1	low	moose	medium	lynx	medium	pika red squirrel	medium

NH1 is moderately important to wildlife. Moose forage here extensively. Boreal species such as white-throated sparrow and spring peeper occur on this Ecosite of limited area.

MANAGEMENT CONSIDERATIONS

Poor drainage, resulting from surface water collection on slowly pervious, fine textured, glaciolacustrine material, severely limits many park uses unless expensive construction techniques are followed.

NT - NUM-TI-JAH ECOSECTION

The Num-Ti-Jah (NT) Ecosection encompasses wet fluvial and fluviolacustrine landforms on col and valley floors in the Upper Subalpine portion of the Subalpine Ecoregion. Gleysolic soils characterize NT but Organic soils are also common on the NT3 Ecosite. The NT2 Ecosite has wet herb and moist shrub thicket vegetation, whereas NT3 has wet herb meadow, cottongrass fen, and sedge fen. Table 85 shows the landform, soil, and vegetational differences of the NT Ecosites. Landscape positions are shown in Figs. 20, 30 and 31.

Table 85. General features of the NT Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
NT2	Level, apron, fan	Fluvial materials A & B (noncalcareous & calcareous, coarse-stratified)	Gleysol	Wet shrub thicket (S8), moist shrub thicket (S4, S11)
NT3	Level, horizontal fen	Fluviolacustrine materials A & B (altered & calcareous, fine-stratified), fen peat	Gleysol, Mesisol	Wet herb meadow (H9), cottongrass fen (H10), sedge fen (H11)

Wetness on NT results from high water tables, seepage, and discharge, resulting in imperfectly to very poorly drained soils. Important accessory deposits include fluviolacustrine materials and fen peat for NT2, fluvial materials for NT3. Soils in active or recently active sedimentation environments lack surface peat layers, whereas soils of geomorphically inactive localities have surface organic layers and include Mesisols on horizontal fens in ponded localities. Although most NT3 tracts are ponded, recent geomorphic conditions favor organic material accumulation. Slopes are often channeled and range from 0 to 15% on NT2, 0 to 3% on NT3.

WILDLIFE

NT is moderately important to wildlife. High densities of small mammals occur on NT3. The Ecosection is used by all species of ungulates but is highly important to deer and moose. Critical winter habitat for white-tailed ptarmigan occurs where there are willow meadows.

Table 86. Wildlife features of the NT Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
NT2	low	deer moose	medium	coyote wolf	low	meadow vole columbian ground squirrel	low
NT3	low	deer moose	low	coyote wolf	high	meadow vole western jumping mouse	medium

MANAGEMENT CONSIDERATIONS

Imperfect to very poor drainage, resulting from high water tables and backwater flooding, severely limits most park uses unless expensive construction techniques are followed. On some NT tracts, sedimentation accompanies flooding. NT3 is of limited areal extent. Vegetation on NT3 is easily damaged and slow to recover from disturbances.

EACH TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

NY - NORQUAY ECOSECTION

The Norquay (NY) Ecosection encompasses calcareous glacial landforms dominated by Brunisolic and Regosolic soils in the Montane Ecoregion. Vegetation includes lodgepole pine forest, Douglas fir open and closed forest, white spruce-Douglas fir forest, and low shrub-herb meadow. Two NY Ecosites are separaterd by genetic material differences and distribution patterns of soils and vegetation (Table 87). Landscape position is shown in Fig. 24.

NY1 occurs on lower valley walls; the linear surface form is considered depositional. Till B (noncalcareous, medium textured) dominates NY1 tracts mapped in the Miette River valley. Slopes range from 30 to 70% and are frequently gullied. Soil and vegetation patterns reflect surface erosional processes and moisture regime. Soils are rapidly to well drained.

NY3 occupies valley floor including benchland positions, usually adjacent to streams. Inclined surfaces are erosional (i.e. river banks), hummocky surfaces are depositional. Slopes range from 15 to 70% and are usually gullied. The pattern of soils and vegetation is governed by aspect, exposure, and erosional processes giving distinct northerly (well drained) versus southerly (rapidly drained) aspects.

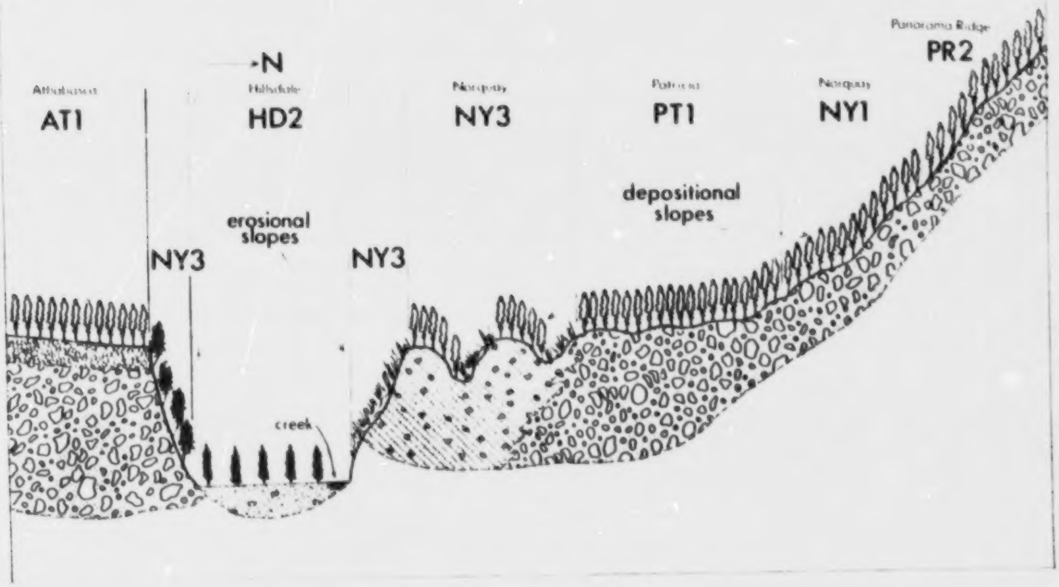
WILDLIFE

NY is very important to wildlife. Critical range for deer, sheep and elk occurs on the open slopes. High densities of small mammals occur on dry areas. Associated with the concentrations of ungulates and small mammals are relatively high numbers of carnivores.

Table 87. General features of the NY Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
NY1	Blanket, veneer over inclined bedrock	Till C (calcareous, medium textured)	Eutric Brunisol > Regosol	Lodgepole pine forest (C6), Douglas fir forest (C1)
NY3	Inclined, hummocky	Ice contact stratified Drift B (calcareous, variably textured)	Northerly: Eutric Brunisol Southerly: Regosol	White spruce - Douglas fir forest (C5), lodgepole pine forest (C19). Douglas fir open and closed forest (O5, C1), low shrub-herb meadow (L1)

Fig. 24 Landscape schematic of the Norquay (NY) Ecosites in relation to other Ecosites.



N
Athabasca
AT1
Hillsdale
HD2
Norquay
NY3
Patricia
PT1
Norquay
NY1
Panorama Ridge
PR2
erosional slopes
depositional slopes
NY3
NY3
creek

Table 88. Wildlife features of the NY Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
NY1	very high	deer bighorn sheep elk	high	wolf coyote cougar	high	columbian ground squirrel	medium
NY3	very high	deer elk bighorn sheep	very high	wolf coyote cougar marten	very high	red squirrel deer mouse heather vole long-tailed vole	high

MANAGEMENT CONSIDERATIONS

Steep and locally eroding slopes are limiting factors to be considered for most park uses on NYI and NY3. Of particular concern on NY3 are the dry, southerly aspects where vegetation removal would increase erosion. Further, the subxeric vegetation of the southerly aspect segment is expected to recover slowly from disturbance. Coarse fragments may impose limitations to use of some slopes.

PL - PEYTO LAKE ECOSECTION

The Peyto Lake (PL) Ecosection encompasses calcareous morainal landforms dominated by Eutric Brunisols and coniferous forest in the Upper Subalpine portion of the Subalpine Ecoregion. Engelmann spruce-subalpine fir closed and open forest, subalpine larch-subalpine fir forest, a distinctive pattern of tundra plus coniferous open forest, and a dry > wet landscape pattern differentiate the four PL Ecosites as outlined in Table 89. Landscape positions are shown in Fig. 25.

PL occurs on valley walls, floors, and shoulders, and in cirque basins and cols. Slopes range from 5 to 70% and are often gullied on PL1. Veneers of Eolian material B (altered, medium textured) occur extensively in western Banff and southwestern Jasper, sporadically elsewhere. Podzolic soils are associated with the eolian veneers. Soils of PL1, PL3, PL4, and dry segments of PL5 are well to moderately well drained and imperfectly to poorly drained on wet segments of PL5. subalpine larch-subalpine fir/grouseberry-everlasting forest occurs only in southern Banff. Lithic soil phases are important on PL4 and PL5, turbic soil phases on PL4. Depressional segments of some PL5 tracts consist of Fluvial material B (calcareous, coarse-stratified).

WILDLIFE

PL is moderately important to wildlife. Large mammals rarely occur here in winter because of the deep snow. In contrast, some hibernating small mammals are very common.

Table 89. General features of the PL Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
PL1	Blanket over inclined bedrock	Till C (calcareous, medium textured)	Eutric Brunisol	Engelmann spruce - subalpine fir closed and open forest (C15, C21, O10)
PL3	Blanket over inclined, hummocky & ridged bedrock	Till C (calcareous, medium textured)	Eutric Brunisol > Humo-Ferric Podzol	Subalpine larch - subalpine fir forest (C23)
PL4	Blanket, veneer over inclined, hummocky & ridged bedrock	Till C (calcareous medium textured)	Eutric Brunisol > Melanic Brunisol, Ferro-Humic Podzol	Heath tundra (L5) > Engelmann spruce-subalpine fir open forest (O10)
PL5	Blanket, veneer over hummocky & ridged bedrock	Till C (calcareous medium textured)	Dry 70: Eutric Brunisol Wet 30: Gleysol, gleyed Podzolic & Brunisolic	Engelmann spruce - subalpine fir closed and open forest (C15, O10), subalpine larch-subalpine fir forest (C23) Wet shrub thicket (S8, S11)

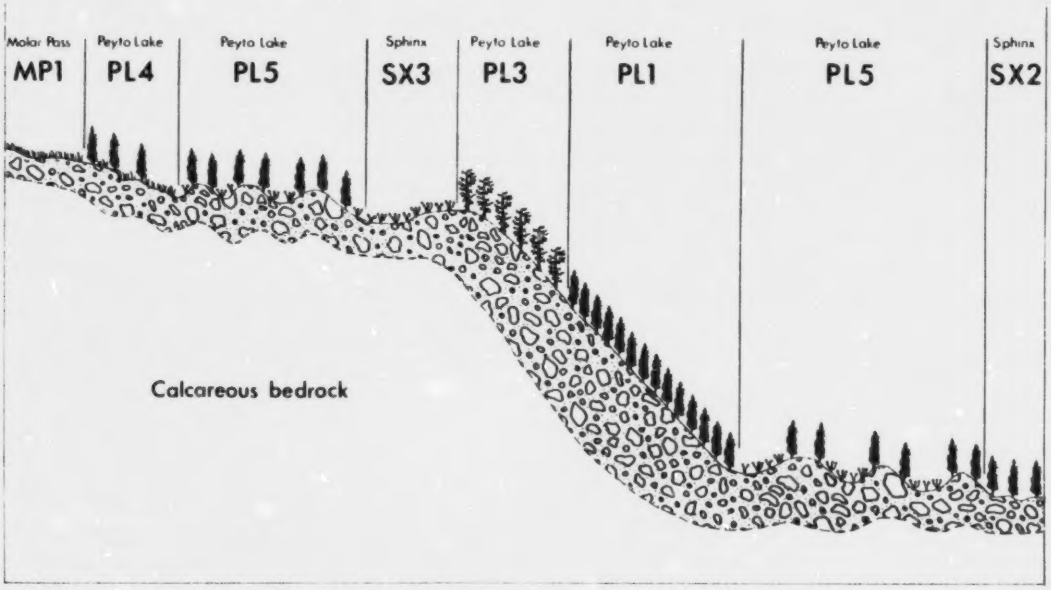
MANAGEMENT CONSIDERATIONS

The PL Ecosites can be treated as having similar responses to management, except for PL3 because of its limited areal extent and the wet segments of PL5 which necessitate special considerations for some uses (e.g. trail construction). Steepness of slope is the major factor to consider in planning of park uses. The eolian veneers, common in some areas, tend to erode easily where vegetation is removed. Locally occurring avalanche paths and occasional seeps will affect certain uses. Heath tundra vegetation on PL4 is slow to recover from disturbances.

PP - PIPESTONE ECOSECTION

The Pipestone (PP) Ecosection encompasses calcareous fluvial apron and fan landforms dominated by Regosolic soils in the Lower Subalpine portion of the Subalpine Ecoregion. Vegetation includes lodgepole pine forest, poplar forest, Engelmann spruce-subalpine fir open and closed forest, white spruce open forest, shrub thicket, shrubby meadow, and herb mat. Table 91 outlines six PP Ecosites separated primarily

Fig. 25 Landscape schematic of the Peyto Lake (PL) Ecosite in relation to other Ecosites.



on vegetational differences.

PP occurs on lower slopes and along streams on valley floors; channeling is a common surface feature. Slopes range from 2 to 45%; soils are rapidly to moderately well drained. Landforms are geomorphologically active and are subject to episodic flooding. PP2 is of limited areal extent and mapped only in Jasper. The majority of PP4 tracts occur close to the Continental Divide and are always found in close proximity to large glaciers or icefields. PP6 and PP7 tracts occur primarily in the Front Ranges.

WILDLIFE

The importance of this Ecosection to wildlife varies with each Ecosite. PP1, PP2, PP3 and PP4 are moderately important, while PP6 and PP7 are highly important. PP6 and PP7 have a well developed shrub and herb layer which increases their importance as foraging areas for ungulates and small mammals. Snow depths up to 1 m restrict ungulate use in winter.

MANAGEMENT CONSIDERATIONS

Management considerations are very similar for PP1, PP2, PP3, PP6 and PP7. Fluvial deposition is sufficiently frequent to maintain the Regosolic soils and is the major factor to consider when planning park uses. Locally occurring coarse textures and high

Table 90. Wildlife features of the PL Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
PL1	medium	caribou	high	marten weasel	low	pika columbian ground squirrel golden-mantled ground squirrel	low
PL3	low	deer	low	wolverine	high	least chipmunk heather vole meadow vole	low
PL4	medium	mountain goat bighorn sheep	medium	weasel wolverine cougar	medium	least chipmunk hoary marmot columbian ground squirrel red-backed vole	medium
PL5	medium	elk	medium	wolf coyote	medium	pika columbian ground squirrel heather vole	low

water tables present problems for sewage disposal, however coarse textured material provides gravel for construction purposes. PP2 is of limited areal extent. PP4 is somewhat different in that its level topography and valley floor positions are conducive to many uses. The active glaciofluvial environment of PP4 is subject to local flooding, high water tables, and shifting stream channels. The coarse textures require the same considerations as for the other PP Ecosites. Vegetation on PP4 can probably withstand moderate use but once destroyed is expected to recover slowly. Major construction activities (e.g. roads) will change sedimentation and erosion patterns on PP4.

EACH PP TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

PR - PANORAMA RIDGE ECOSECTION

The Panorama Ridge (PR) Ecosection encompasses calcareous glacial landforms dominated by a Brunisolic > Luvisolic soil complex and lodgepole pine forest within the Lower Subalpine portion of the Subalpine Ecoregion. Genetic material differences, episodic seepage, a northerly-southerly aspect landscape pattern, and vegetational differences separate the five PR Ecosites (Table 93). Landscape positions are shown in Fig. 26.

PR occurs on valley walls and floors including benchlands. Veneers of Eolian material B (altered, medium textured) occur locally especially in western Banff and southwestern Jasper. Slopes range from 15 to 70% and are often gullied except on PR3 where failed slopes are common. Soils of PR1, PR2, and PR6 are well drained; soils of PR3 are imperfectly drained and are affected by eposodic, near-surface seepage. PR4 landforms are erosional and the pattern of soils and vegetation is governed by northerly (well to moderately well drained) versus southerly (rapidly to well drained) aspects.

Table 91. General features of the PP Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
PP1	Fan, apron	Fluvial material B (calcareous, coarse -stratified)	Regosol	Lodgepole pine forest (C19, C3, C6)
PP2	Fan, apron	Fluvial material B (calcareous, coarse -stratified)	Regosol	Poplar forest (C16, C17)
PP3	Fan, apron	Fluvial material B (calcareous, coarse -stratified)	Regosol	Engelmann spruce-subalpine fir forest (C13, C31)
PP4	Fan, level	Glaciofluvial material B (calcareous, coarse textured)	Regosol	Herb mat (H8)
PP6	Fan, apron	Fluvial material B (calcareous, coarse -stratified)	Regosol	Engelmann spruce-subalpine fir open forest (O18), white spruce open forest (O17).
PP7	Fan, apron	Fluvial material B (calcareous, coarse-stratified)	Humic Regosol, Regosol	Shrubby meadow (S9), shrub thicket (S10)

WILDLIFE

PR is moderately important to wildlife. For some carnivores and many small mammals, most Ecosites are highly or very important. There is little forage to attract ungulates to this Ecosection and deep snow restricts most large mammal presence in winter.

MANAGEMENT CONSIDERATIONS

The PR1, PR2, and PR4 Ecosites have management concerns that are similar. Steepness of slope is the major factor to consider in planning of park uses. Locally occurring avalanche paths and seeps on PR1 and PR2, and locally eroding slopes on PR4 will affect certain uses.

Episodic, subsurface lateral water flow is the salient characteristic to be considered in planning park uses of PR3. The land surface is relatively dry, except for seeps, and presents no limits to low intensity uses on undisturbed surfaces. However, removal of surface and subsurface material may create seepage-induced slope failure. Slope failure is a common feature of PR3 and could be a continuing problem in some areas, e.g. a PR3/7c tract at Village Lake Louise in Banff that was investigated by TES Research and Consulting Ltd. (1973).

Table 92. Wildlife features of the PP Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
PP1	medium	elk	high	wolf coyote lynx cougar	medium	snowshoe hare columbian ground squirrel golden-mantled ground squirrel red squirrel red-backed vole	medium
PP2	medium	elk deer	very high	wolf weasel cougar	medium	dusky shrew red squirrel deer mouse meadow vole	medium
PP3	medium	moose	high	lynx	high	snowshoe hare golden-mantled ground squirrel deer mice porcupine	medium
PP4	medium	moose	medium		medium		low
PP6	high	moose elk	very high	wolf coyote weasel lynx cougar	high	snowshoe hare least chipmunk deer mouse	low
PP7	very high	moose elk	high	wolf cougar	low	columbian ground squirrel	low

PR6 has no characteristics limiting for campgrounds, trails, or related uses. Locally occurring coarse textured materials provide gravel sources but may present problems in sewage disposal due to ineffective ion filtration.

PT - PATRICIA ECOSECTION

The Patricia (PT) Ecosection encompasses calcareous glacial landforms dominated by Brunisolic and Luvisolic soils in the Montane Ecoregion. Vegetation is dominated by lodgepole pine and aspen forests. Four PT Ecosites are differentiated by vegetation, lithic soil phases, and a dry > wet landscape pattern (Table 95). Landscape positions are shown in Figs. 27 and 24.

PT occurs on valley floor benchlands; Ice Contact Stratified Drift B (calcareous, variably textured) is a significant constituent of some tracts. Veneers of Eolian material A (calcareous, medium textured) and Eolian material B (altered, medium textured) occur sporadically. Soils of PT1, PT3, PT4 and dry segments of PT5 are rapidly to well drained; poorly to very drained on wet segments of PT5. Bedrock outcrops are common on PT3. Slopes range from 2 to 70% and are usually complex.

Table 93. General features of the PR Ecosites.

Ecosite	Surface Expression	Genetic Material Unit	Soil	Vegetation
PR1	Blanket over inclined bedrock	Till C (calcareous, medium textured)	Eutric Brunisol > Gray Luvisol	Lodgepole pine forest (C11,C20, C29)
PR2	Blanket over inclined bedrock	Till C (calcareous, medium textured)	Eutric Brunisol > Gray Luvisol	Lodgepole pine/ buffaloberry (C6, C18, C19)
PR3	Blanket over inclined & hummocky bedrock, hummocky	Till C (calcareous, medium textured)	Gleyed Eutric Brunisol > gleyed Gray Luvisol	Lodgepole pine/ buffaloberry (C18, C19)
PR4	Inclined	Till C (calcareous, medium textured) and Ice contact stratified Drift B (calcareous, variably textured)	Northerly: Eutric Brunisol Southerly: Eutric Brunisol > Gray Luvisol, Regosol	Engelmann spruce - subalpine fir forest (C13, C14) Lodgepole pine forest (C3, C6, C19)
PR6	Blanket over inclined & hummocky bedrock, hummocky	Ice contact stratified Drift B (calcareous, variably textured)	Eutric Brunisol > Gray Luvisol	Lodgepole pine forest (C11, C18, C19, C29)

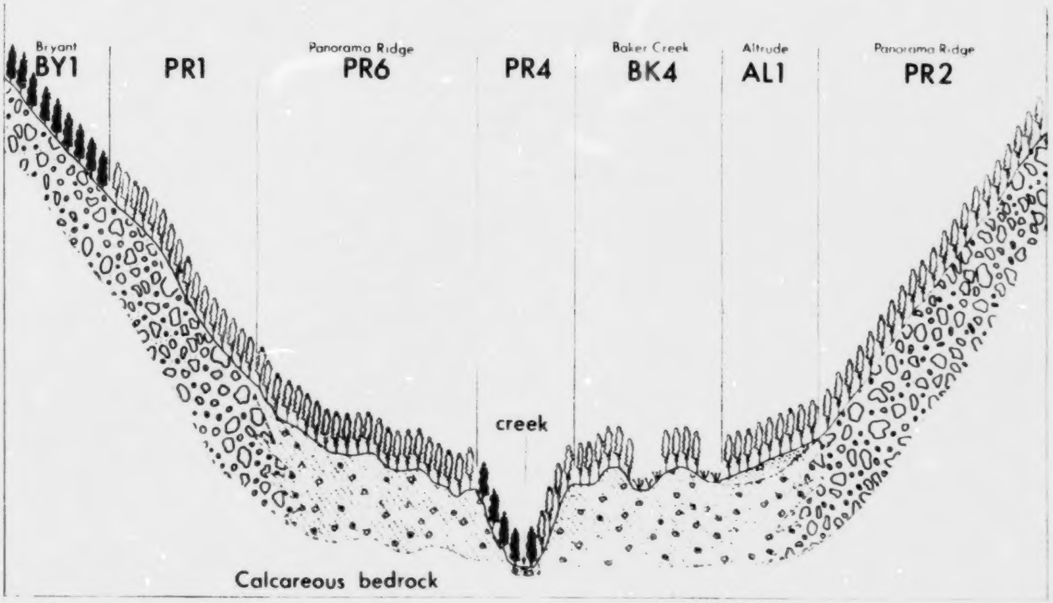
WILDLIFE

PT is highly important to wildlife. Located in the warmer Montane zone with low snow acumulation, it is winter range for elk and deer. Some small mammals, especially red squirrels, occur here in large numbers while carnivores also concentrate here. Breeding bird densities are high to very high.

MANAGEMENT CONSIDERATIONS

The PT Ecosites can all be treated similarly regarding management concerns, except for PT4 because of its limited areal extent. Also, the wet segments of PT5 necessitate special considerations for some uses (e.g. trail construction). Tracts with gentle slopes generally have no characteristics limiting for park uses. Moderate to steep, irregular slopes with shallow soils and bedrock outcrops are major factors in planning park uses, especially on PT3 where colluviation is common on exceptionally steep south facing slopes. The textural variability of ice contact stratified drift, common on some valley floor tracts, may influence some uses.

Fig. 26 Landscape schematic of the Panorama Ridge (PR) Ecosite in relation to other Ecosites



RD - REDOUBT ECOSECTION

The Redoubt (RD) Ecosection (Table 97) encompasses inclined, noncalcareous, medium textured colluvium in the Alpine Ecoregion. Soils are Dystric and Sombric Brunisols, Regosolics, and Humic Regosols. Vegetation is characterized by mountain avens tundra and heath tundra. Landscape position is shown in Figs. 20 and 31.

RD1 occurs on steep, usually linear slopes in areas that are geologically dominated by Miette Group in the Main Ranges or noncalcareous Mesozoic strata in the Front Ranges. Colluvial processes are locally active and include avalanching, soil creep, cryoturbation and solifluction. Slopes range from 45 to 70%. Soils are well drained. Unvegetated portions may constitute up to 50% of RD1 tracts.

WILDLIFE

RD1 is moderately important to wildlife but highly important for sheep, goats and some small mammals. In winter these areas are frequently blown free of snow allowing ungulates to graze easily.

Table 94. Wildlife features of the PR Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
PR1	low	deer	high	wolf wolverine	low	columbian ground squirrel golden-mantled ground squirrel	high
PR2	medium	elk	very high	marten weasel lynx wolf coyote cougar	medium	snowshoe hare columbian ground squirrel golden-mantled ground squirrel red squirrel red-backed vole	low
PR3	medium	moose	medium		high	red-backed vole long-tailed vole	medium
PR4	medium		high	coyote marten wolverine	very high	golden-mantled ground squirrel red squirrel deer mouse red-backed vole long-tailed vole western jumping mouse	medium
PR6	medium	deer	high	marten lynx wolf coyote cougar	medium	snowshoe hare porcupine	medium

MANAGEMENT CONSIDERATIONS

Steep and locally unstable (colluviating) slopes are limiting factors for many park uses. Slope failure is a feature of some RD1 tracts. Potential for slope failure is unknown. Removal of vegetation will result in wind, water, and gravity erosion. Vegetation is expected to recover slowly from disturbances.

RK - ROCKY ECOSECTION

The Rocky (RK) Ecosection encompasses glaciolacustrine landforms dominated by Luvisolic and Brunisolic soils and lodgepole pine forest in the Montane Ecoregion (Table 99). Landscape position is shown in Fig. 23.

RK1 is mapped only in Jasper and occurs on valley floor benchlands. The glaciolacustrine material overlies Ice Contact Stratified Drift B (calcareous, variable textured). Surficial veneers of Eolian material B (altered, medium textured) occur on some tracts. Slopes range from 2 to 10%. Soils are well to moderately well drained.

WILDLIFE

Table 95. General features of the PT Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
PT1	Ridged & hummocky including bedrock control (blanket)	Till C (calcareous, medium textured)	Eutric Brunisol, Gray Luvisol	Lodgepole pine forest (C6,C19)
PT3	Veneer over ridged bedrock > ridged bedrock	Till C (calcareous, medium textured	Eutric Brunisol > Gray Luvisol (lithic phases)	Lodgepole pine forest (C3, C6, C19)
PT4	Ridged including bedrock control (blanket)	Till C (calcareous, medium textured)	Eutric Brunisol, Gray Luvisol	Aspen forest (C16)
PT5	Ridged > horizontal fen	Till C (calcareous, medium textured) > fen peat	Dry 60: Eutric Brunisol, Gray Luvisol Wet 40: Gleysol Mesisol	Lodgepole pine forest (C6, C11, C19) Black spruce-lodgepole pine forest (C8), spruce open forest

Table 96. Wildlife features of the PT Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
PT1	high	deer elk	high	coyote cougar wolf	high	red squirrel red-backed vole	high
PT3	high	deer moose elk	high	cougar wolf coyote	high	red squirrel deer mouse big brown bat	high
PT4	medium	deer bighorn sheep elk	high	wolf coyote cougar	high	red squirrel meadow vole	very high
PT5	medium	deer	high	coyote cougar lynx wolf	medium	snowshoe hare red squirrel meadow vole	high

RK1 is moderately important to wildlife overall but very important to small mammals.

MANAGEMENT CONSIDERATIONS

Although considered to be dry (well to moderately well drained), the slow infiltration and permeability rates of the fine textured glaciolacustrine material will create problems where water can collect (e.g. depressions on trails). Removal of vegetation will significantly increase the chances for water and wind erosion, including slumps.

Fig. 27 Landscape schematic of the Patricia (PT) Ecosites in relation to other Ecosites.

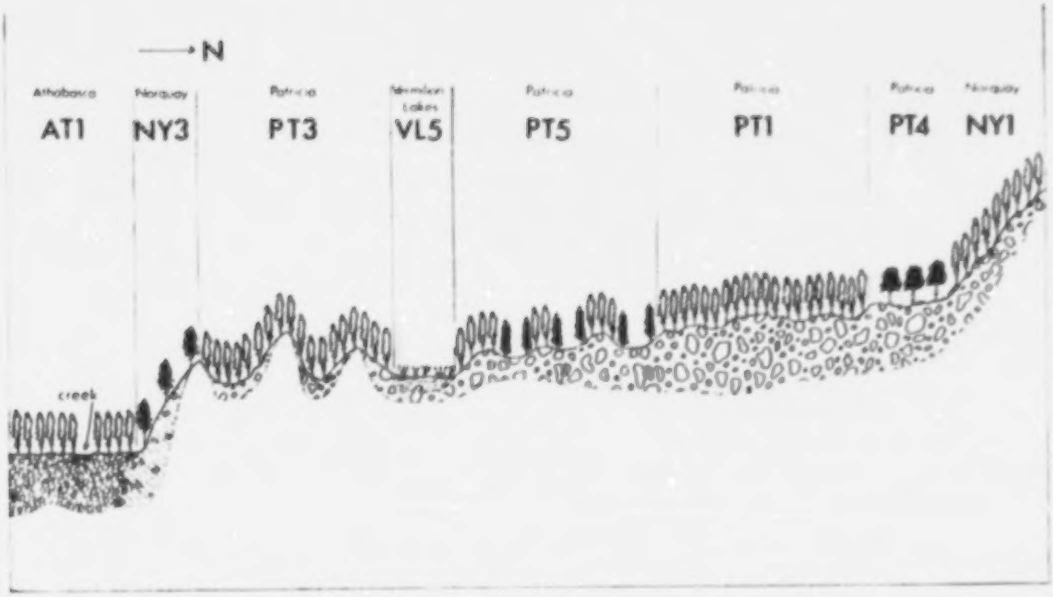

N
Athabasca
AT1
Norquay
NY3
Patricia
PT3
Vermilion Lakes
VL5
Patricia
PT5
Patricia
PT1
Patricia
PT4
Norquay
NY1
creek

Table 97. General features of the RD1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
RD1	Blanket & veneer over inclined bedrock	Colluvium B (non-calcareous, medium textured)	Dystric & Sombric Brunisol, Regosol, Humic Regosol	Mountain avens tundra (H1), heath tundra (L5)

Table 98. Wildlife features of the RD1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
RD1	high	bighorn sheep mountain goat	low		medium	pika hoary marmot columbian ground squirrel golden-mantled ground squirrel	low

Table 99. General features of the RK1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soil	Vegetation
RK1	Glaciolacustrine blanket over undulating & hummocky glacial materials	Glaciolacustrine material (calcareous, fine textured)	Gray Luvisol > Eutric Brunisol	Lodgepole pine forest (C19, C29)

SB - SAWBACK ECOSECTION

The Sawback (SB) Ecosection encompasses inclined landforms of calcareous, medium textured colluvium in the Lower Subalpine portion of the Subalpine Ecoregion. Brunisolic and Regosolic soils dominate under avalanche complex v.t.s., Engelmann spruce-subalpine fir forest, lodgepole pine forest, coniferous open forest, shrub-herb meadow, and grassland. The five SB Ecosites are separated primarily by vegetational features (Table 101). Landscape positions are shown in Figs. 28 and 29.

SB occurs on or below steep valley walls and is associated with calcareous bedrock. Slopes generally range from 45 to 100% and snow avalanching characteristically affects more than 50% SB1. Soils are rapidly to moderately well drained. Unvegetated portions constitute up to 50% of some SB1 and SB4 tracts. SB5 occurs primarily in the Front Ranges on dry, southerly aspects. SB4 is the steepest of the five SB Ecosites and has the greatest abundance of lithic soils and bedrock outcrops. Avalanche Compex 1, for SB1, is a heterogeneous complex of v.t.s. that includes subalpine fir-willow (S2), willow-dwarf birch-shubby cinquefoil (S10), hairy wild rye-wild strawberry-fireweed (H5), aspen/hairy wild rye-showy aster (C22), plus intergrades, with S2 and H5 being most abundant.

Table 100. Wildlife features of the RK1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
RK1	low	elk	medium	lynx cougar	very high	masked shrew snowshoe hare least chipmunk red squirrel deer mouse	medium

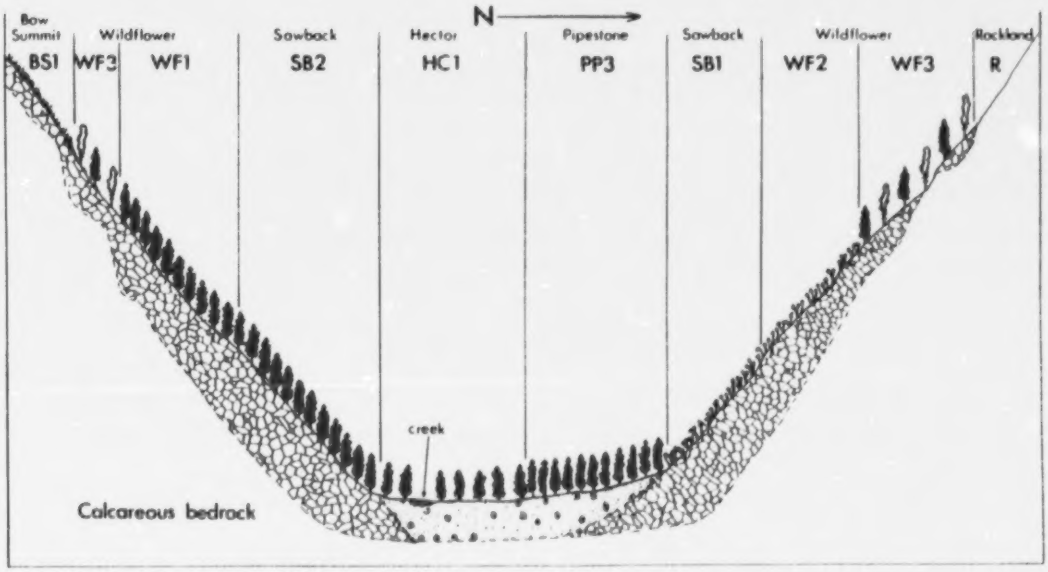
Table 101. General features of the SB Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
SB1	Blanket over inclined bedrock, apron	Colluvium C (calcareous, medium textured	Eutric Brunisol, Regosol, Humic Regosol	Avalanche Complex 1 > Engelmann spruce - subalpine fir forest (C13, C14)
SB2	Blanket over inclined bedrock, apron	Colluvium C (calcareous, medium textured	Eutric Brunisol, Regosol	Engelmann spruce - subalpine fir forest (C13, C14)
SB3	Blanket over inclined bedrock, apron	Colluvium C (calcareous, medium textured)	Eutric Brunisol, Regosol	Lodgepole pine forest (C3, C6, C19)
SB4	Blanket, veneer over inclined bedrock > inclined bedrock	Colluvium C (calcareous, medium textured)	Eutric Brunisol, Regosol, Humic Regosol	Coniferous open forest (04, 017) > lodgepole pine forest (C3), shrub-herb meadow (L1)
SB5	Blanket, veneer over inclined bedrock	Colluvium C (calcareous, medium textured)	Eutric & Melanic Brunisol, Humic Regosol	Grassland (H14)

Table 102. Wildlife features of the SB Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
SB1	high	mountain goat bighorn sheep	medium		high	masked shrew pika least chipmunk deer mouse long-tailed vole western jumping mouse	high
SB2	medium		low		medium	western jumping mouse	medium
SB3	medium	moose bighorn sheep	high	marten wolverine coyote	high	snowshoe hare yellow pine chipmunk	low
SB4	medium	mountain goat bighorn sheep	low	cougar	medium	pika least chipmunk	medium
SB5	very high	bighorn sheep deer elk mountain goat	medium	cougar wolf coyote	medium	deer mouse	low

Fig. 28 Landscape schematic of the Sawback Ecosites in relation to other Ecosites.



SB is highly important for wildlife. Critical winter range for sheep and goats occurs here as well as high densities of some small mammals, birds and carnivores. Located in the Front Ranges, SB Ecosites do not receive much snow and consequently ungulates can easily crater for forage, especially on SB5.

MANAGEMENT CONSIDERATIONS

Steep and locally unstable (colluviating) slopes are limiting factors to be considered for many park uses. Snow avalanching, whether local (on SB2, SB3, SB4) or extensive (SBl), will affect winter uses. Shallow soils and bedrock outcrops on SB4 are factors to be considered when planning certain uses (e.g. trails). It is expected that vegetation on SB4 and SB5 recovers slowly from disturbances and that vegetation removal on SB5 will significantly increase erosion, particularly colluviation. Droughty conditions on SB5 will compound potential revegetation problems.

SF - SNOWFLAKE ECOSECTION

The Snowflake (SF) Ecosection (Table 103) encompasses morainal landforms dominated by Cryosolic soils and Engelmann spruce-subalpine fir forest in the Upper Subalpine portion of the Subalpine Ecoregion. The SF Ecosection develops on northerly aspects in the Front Ranges of both Banff and Jasper, from Banff townsite northwestward. Landscape position is shown in Fig. 29.

Table 103. General features of the SF1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
SF1	Blanket over inclined bedrock	Till B & C (noncalcareous & calcareous, medium textured)	Static Cryosol >Gleyed Eutric Brunisol	Engelmann spruce - subalpine fir forest (C13, C24)

SF1 occurs on valley wall slopes and is associated with materials derived from Mesozoic strata. Failed and soliflucted slopes are common; slopes range from 30 to 70%. The Cryosolic soils are frozen to within 1 m of the surface throughout the year. The soils are imperfectly drained. The Engelmann spruce-subalpine fir/rock willow/white mountain heather v.t. is more abundant than Engelmann spruce-subalpine fir/feathermoss forest.

WILDLIFE

Table 104. Wildlife features of the SF1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
SF1	high	elk	medium	wolf cougar	medium	snowshoe hare red-backed vole porcupine	medium

SF1 is moderately important to all groups of wildlife. It is most important to large mammals in summer. Snow depths up to 0.8 m restrict large mammal movement in winter.

MANAGEMENT CONSIDERATIONS

Permafrost and solifluction in the active layer are the two main features that limit park uses to activities that do not disturb the insulation and thermal balance. Removal of vegetation and surface organic layers will increase the active layer depth, possibly resulting in slope failure. Road construction, in particular, should avoid SF1 tracts.

SP - SPRAY ECOSECTION

The Spray (SP) Ecosection encompasses glaciolacustrine landforms dominated by Luvisolic and Brunisolic soils and lodgepole pine forest in the Lower Subalpine portion of the Subalpine Ecoregion. Table 105 outlines the features of the SP1 Ecosite.

SP1 occupies valley floor and lower slope positions. Surficial veneers of Eolian

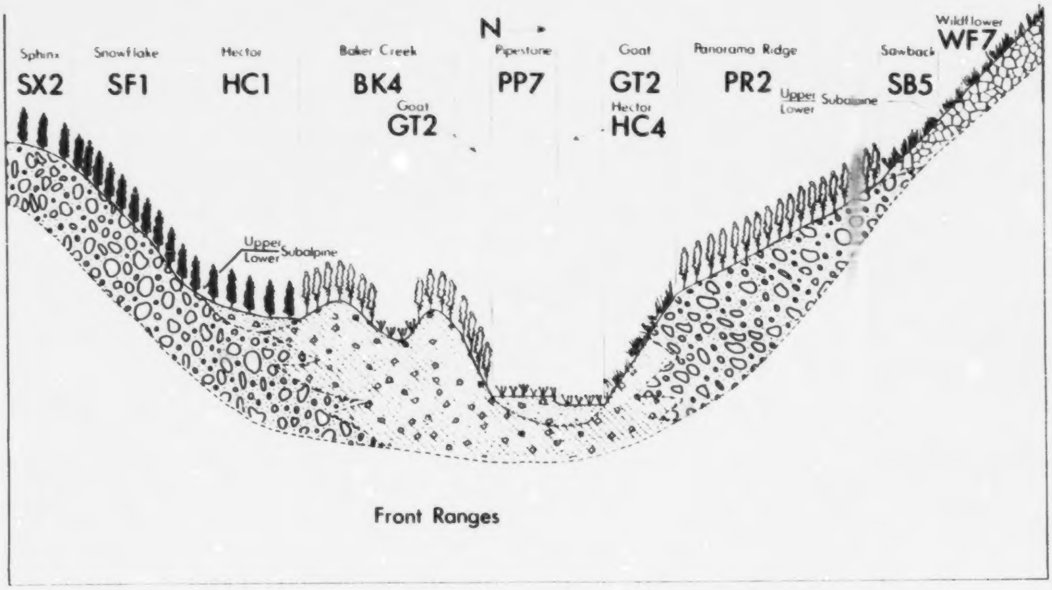

N
Sphinx
SX2
Snowflake
SF1
Hector
HC1
Baker Creek
BK4
Goat
GT2
Pipestone
PP7
Goat
GT2
Hector
HC4
Panorama Ridge
PR2
Upper
Lower
Subalpine
Sawback
SB5
Wildflower
WF7
Upper
Lower
Subalpine
Front Ranges

Fig. 29 Landscape schematic of the Snowflake 1 (SF1) Ecosite in relation to other Ecosites.

Table 105. General features of the SP1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
SP1	Glaciolacustrine veneer & blanket over undulating & hummocky glacial materials	Glaciolacustrine material (calcareous, fine textured) over Ice contact stratified Drift B (calcareous, variably textured)	Gray Luvisol, Eutric Brunisol	Lodgepole pine forest (C18, C19)

material B (altered, medium textured) occur occasionally. Slopes are between 2 and 15%. Soils are well to moderately well drained. On some SP1 tracts Till C (calcareous, medium textured) underlies the glaciolacustrine material.

WILDLIFE

Table 106. Wildlife features of the SP1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
SP1	medium	elk	medium	cougar	low	red squirrel	medium

This Ecosite is moderately important to wildlife. However, very few species occur here in high numbers. Snow depths up to 1.2 m restrict ungulate movement in winter.

MANAGEMENT CONSIDERATIONS

Even though SP1 is well to moderately well drained, the slow infiltration and permeability rates of the glaciolacustrine material will create problems wherever water can collect (e.g. depressions on trails). Removal of vegetation will significantly increase the chances for water and wind erosion, including slumps.

SX - SPHINX ECOSECTION

The Sphinx (SX) Ecosection encompasses moist to wet morainal landforms in the Upper Sublapine portion of the Subalpine Ecoregion. Soils are genetically related Gleysolics, gleyed Podzolics, and gleyed Brunisolics. Vegetation reflects varying seepage conditions and includes moist herb meadow, dwarf shrub-herb meadow, heath tundra, moist shrub thicket, wet shrub thicket, and Engelmann spruce-subalpine fir open forest. Table 107 outlines the features of the three SX Ecosites, seperated primarily by vegetational differences.

SX occurs on floors, benchlands, walls, and shoulders within valleys, cols, and cirques. Wetness is attributed to seasonal and episodic seepage giving imperfectly to poorly drained soils. The discontinuous fluviolacustrine material was derived locally by sheet erosion of morainal surfaces and reworking of postglacial eolian deposits. Solifluction is common, especially on SX1, and contributes to the occurrence of turbic phase soils. Slopes range from 5 to 45%.

WILDLIFE

SX is moderately important to wildlife. Some small mammals reach very high densities on SX Ecosites and, in addition, SX supports many species of small mammals. In summer, many areas in Jasper are highly important range for caribou. In winter, snow is too deep for ungulates to occur here.

Table 107 General features of the SX Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
SX1	Morainal blanket over inclined, hummocky, to ridged bedrock > fluviolacustrine veneer	Till B (noncalcareous, medium textured) > Fluviolacustrine material A (altered, fine-stratified)	Gleysol, gleyed Podzolic, Gleyed Dystric Brunisol	Moist herb meadow (H16), dwarf shrub-herb meadow (L7) > heath tundra (L5), wet shrub thicket (S8)
SX2	Morainal blanket over inclined, hummocky, & ridged bedrock > fluviolacustrine veneer	Till B & C (noncalcareous & calcareous, medium textured) > Fluviolacustrine material A (altered, fine-stratified)	Gleysol, gleyed Podzolic, Gleyed Dystric Brunisol	Engelmann spruce - subalpine fir open forest (O9,O10)
SX 3	Morainal blanket over inclined, hummocky & ridged bedrock > fluviolacustrine veneer	Till B & C (noncalcareous & calcareous, medium textured) > Fluviolacustrine material A (altered, fine-stratified)	Gleysol, gleyed Podzolic, Gleyed Eutric Brunisol	Moist shrub thicket (S4), wet shrub thicket (S8)

Table 108. Wildlife features of the SX Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
SX1	low	caribou	medium	weasel	high	dusky shrew hoary marmot columbian ground squirrel northern bog lemming long-tailed vole porcupine	low
SX2	medium	moose	high	marten weasel wolverine wolf coyote	medium	masked shrew columbian ground squirrel red-backed vole heather vole porcupine	medium
SX3	high	caribou bighorn sheep	medium		medium	beaver	high

MANAGEMENT CONSIDERATIONS

Imperfect to poor drainage resulting from seepage is the major factor limiting most park uses. Moist, herb dominated v.t.s may be expected to recover quickly after moderate disturbances but will not tolerate heavy or prolonged use. Solifluction is common locally and may limit some uses. Removal of vegetation is expected to increase erosion, particularly solifluction.

TA - TALBOT ECOSECTION

The Talbot (TA) Ecosection encompasses surficial eolian veneers overlying glacial deposits in the Montane Ecoregion. Regosolic soils dominate under white spruce forest, grassland, and low shrub-herb meadow vegetation. Table 109 separates the two TA Ecosites, primarily by vegetational differences. Landscape positions are shown in Fig. 16.

Table 109. General features of the TA Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
TA2	veneer over inclined bedrock	Eolian material A (calcareous, medium textured)	Regosol	Grassland (H6), low shrub-herb meadow (L1)
TA3	Veneer over glacial blanket over hummocky and ridged bedrock	Eolian material A (calcareous, medium textured) over Ice contact stratified Drift B (calcareous, variably textured).	Regosol > Eutric Brunisol	White spruce forest (C2, C26, C27)

TA occurs on lower slopes and benchlands of major river valleys. Slopes range from 30 to 70% on TA2, from 5 to 70% on TA3. Soils are extremely calcareous and rapidly to well drained. TA2 occurs only in Jasper and is most common on southerly and easterly facing erosional scarps. The white spruce/fern moss and white spruce/prickly rose/fern moss v.t.s of TA3 occur only in Jasper.

WILDLIFE

This Montane Ecosection is very important to wildlife. The grasslands are critical winter range for elk, deer and sheep in many areas. Very high densities of deer mice occur on TA2. Wolf, cougar, and coyote are attracted by the high prey densities. The relatively warm climate, shallow snow accumulation and patches of forest enhance attractiveness of to wildlife.

MANAGEMENT CONSIDERATIONS

Regosolic soils dominate and indicate current and recent eolian deposition. Removal of vegetation is likely to result in wind and water erosion. Steep slopes and droughty conditions compound such potential erosion problems. Vegetation of TA3 is more resilient than that of TA2, but removal of vegetation is also expected to result in wind and water erosion, particularly on steep slopes.

Table 110. Wildlife features of the TA Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
TA2	very high	bighorn sheep mountain goat deer	medium	wolf cougar coyote	very high	deer mouse heather vole	medium
TA3	very high	elk bighorn sheep deer moose	high	cougar wolf coyote marten	medium	red squirrel	high

TK - TEKARRA ECOSECTION

The Tekarra (TK) Ecosection (Table 111) encompasses inclined landforms of noncalcareous, coarse textured colluvium in the Alpine Ecoregion. Dystric and Sombric Brunisols and Regosolics occur under heath tundra and mountain avens tundra.

Table 111. General features of the TK1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
TK1	Blanket, veneer over inclined bedrock	Colluvium A (noncalcareous, coarse textured)	Dystric & Sombric Brunisol, Regosol	Heath tundra (L5), mountain avens tundra (H1)

TK1 occurs on steep, usually linear slopes in Main Ranges areas that are geologically dominated by Gog Group quartzites. Surface veneers of Eolian material B (altered, medium textured) occur sporadically. Slopes commonly range from 45 to 100%. Soils are well drained. Colluvial processes are locally active and include avalanching and soil creep. Unvegetated portions may constitute up to 50% of TK1 tracts.

WILDLIFE

TK is of low importance to wildlife.

MANAGEMENT CONSIDERATIONS

Steep and locally unstable (colluviating) slopes are limiting factors to be considered for many park uses. Removal of vegetation is likely to result in water and gravity erosion. Vegetation is expected to recover slowly from disturbances. Stony surfaces (coarse fragments) will affect certain uses such as trails.

Table 112. Wildlife features of the TK1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
TK1	low		low		low	pika	medium

TR - TYRRELL ECOSECTION

The Tyrrell (TR) Ecosection encompasses dry to moist, shrubland and grassland dominated, morainal landforms in the Upper Subalpine portion of the Subalpine Ecoregion. Both calcareous and noncalcareous, medium textured tills form the moraines. Soils are Eutric and Melanic Brunisols. The features of the two TR Ecosites are outlined in Table 113. Landscape positions are shown in Fig. 30.

Table 113. General features of the TR Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
TR1	Blanket, veneer over inclined, hummocky & ridged bedrock	Till B & C (non-calcareous & calcareous, medium textured)	Eutric Brunisol > Melanic Brunisol	Dry shrub thicket (S10), moist shrub thicket (S12), Engelmann spruce-subalpine fir open forest (O18)
TR2	Blanket, veneer over inclined, hummocky & ridged bedrock	Till B & C (non-calcareous & calcareous, medium textured)	Eutric & Melanic Brunisol	Grassy tundra (H4), dry grassland (H14)

TR occurs on most topographic positions and is most extensive in the Front Ranges in association with Mesozoic and adjacent strata. Wet terrain is important on some TR1 tracts where it is associated with fluvial materials along streams. Slopes generally range from 5 to 45% on TR1 and from 30 to 70% on TR2. Tundra vegetation, including the mountain avens-snow willow-moss campion, mountain avens-kobresia-bearberry, white mountain heather-mountain avens-snow willow and heather-everlasting v.t.s, is important locally on TR1. Exposure, steepness of slope, and southerly aspects account for the dominant grassy vegetation on TR2.

WILDLIFE

TR is highly important to wildlife, particularly large mammals in summer. In winter, deep snow precludes large mammal activity in many areas.

Fig. 30 Landscape schematic of the Tyrrell (TR) Ecosites in relation to other Ecosites.

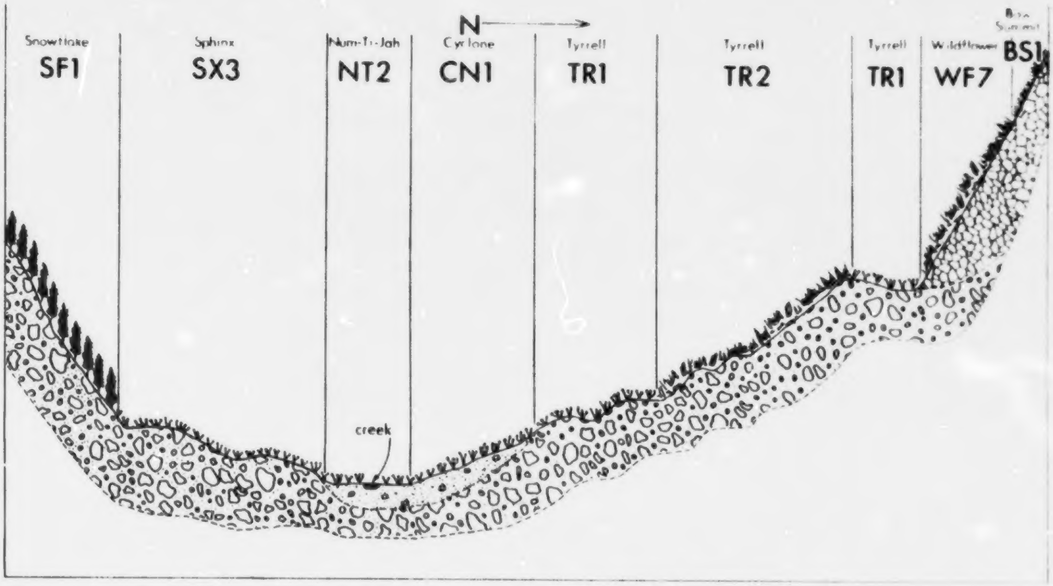

N
Snowflake
SF1
Sphinx
SX3
Num-Ti-Jah
NT2
Cyclone
CN1
Tyrrell
TR1
Tyrrell
TR2
Tyrrell
TR1
Wildflower
WF7
Bow Summit
BS1
creek

Table 114. Wildlife features of the TR Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
TR1	high	elk bighorn sheep	high	coyote wolf cougar	medium	least chipmunk hoary marmot	medium
TR2	high	elk bighorn sheep mountain goat caribou	high	coyote weasel cougar wolf	low		medium

MANAGEMENT CONSIDERATIONS

TR1 tracts with gentle slopes have no outstanding features limiting for park uses. Problems may arise with locally occurring features such as the complex tundra vegetation on hummock and ridge crests, wet terrain on depressional localities, and solifluction and cryoturbation on seepage affected sites.

On TR2 tracts, steepness of slope is the major factor to consider in planning of park uses. The degree of vegetation fragility is not known, but it is expected that vegetation recovers slowly after disturbance and that vegetation removal will significantly increase the chances of erosion. Droughty conditions compound potential revegetation problems.

TZ - TOPAZ ECOSECTION

The Topaz (TZ) Ecosection encompasses glacial and glaciofluvial landforms comprised of noncalcareous, coarse textured, ice contact stratified and glaciofluvial materials within the Lower Subalpine portion of the Subalpine Ecoregion. TZ is dominated by Dystric Brunisols and lodgepole pine forest. The features of the two TZ Ecosites, separated on the occurrence of a dry > wet versus an all dry landscape pattern, are outlined in Table 115. Landscape positions of the TZ Ecosites are shown in Fig. 8.

Table 115. General features of the TZ Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
TZ1	Ridged, hummocky & terraced	Ice contact stratified Drift A & Glaciofluvial material A (noncalcareous, coarse textured)	Dystric Brunisol	Lodgepole pine forest (C35, C19)
TZ2	Ridged, hummocky	Ice contact stratified Drift A (noncalcareous, coarse textured)	Dry 70: Dystric Brunisol	Lodgepole pine forest (C35, C19)
			Wet 30: Gleysol > Mesisol	Wet Engelmann spruce - subalpine fir open forest (O6), wet spruce open forest (O11), wet shrubby meadow (S1), birch fen (S3)

TZ occurs on valley floors and lower slopes in the Main Ranges in Jasper, usually in association with Gog Group (quartzite) bedrock. Slopes range from 2 to 45% and are frequently channeled. Soils of the dry upland portions are rapidly drained; soils of wet depressions of TZ2 are imperfectly to very poorly drained. Lower B horizons of dry soils are often weakly cemented (duric tendency).

WILDLIFE

TZ is of moderate importance to wildlife. Only some small mammals occur here in high densities.

Table 116. Wildlife features of the TZ Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
TZ1	low		medium		medium	red squirrel red-backed vole heather vole	medium
TZ2	low		medium		low	snowshoe hare porcupine	low

MANAGEMENT CONSIDERATIONS

Both TZ Ecosites are of limited extent. Valley floor tracts with gentle slopes are convenient for many park uses, but other features should be considered. Coarse textured material provides gravel and sand for construction purposes, but such coarse textures are ineffective ion filters and thus present problems in sewage disposal. Abundant lichen vegetation occurs in some areas and is thought to be easily damaged and slow to recover from disturbances. Stony surfaces in some localities will affect trail and campsite construction. Characteristic dry > wet landscape pattern of TZ2 necessitates special considerations in planning certain park uses (e.g. trails).

VD - VERDANT ECOSECTION

The Verdant (VD) Ecosection encompasses fan and apron landforms consisting of noncalcareous, fluvial material within the Lower Subalpine portion of the Subalpine Ecoregion. It is dominated by Brunisolic soils with either spruce or pine forests. Table 117 outlines features of the VD Ecosites.

Table 117. General features of the VD Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
VD1	Fan, apron	Fluvial material A (noncalcareous, coarse-stratified)	Dystric Brunisol	Engelmann spruce-subalpine fir forest (C13, C14)
VD2	Fan, apron	Fluvial material A (noncalcareous, coarse-stratified)	Dystric Brunisol	Lodgepole pine forest (C19, C20)

VD occurs on lower slopes and valley floors. Veneers of Eolian material B (altered, medium textured) occur occasionally. Linear slopes between 2 and 30% are characteristic. Soil development reflects recent geomorphic stability. Soils are well to moderately well drained.

WILDLIFE

Table 118. Wildlife features of the VD Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
VD1	low	moose	high	weasel lynx	high	snowshoe hare red squirrel red-backed vole	low
VD2	low	moose	high	marten weasel wolverine	low		low

VD is moderately important to wildlife. It is highly important to carnivores but of low importance to ungulates, birds and some small mammals.

MANAGEMENT CONSIDERATIONS

VD1 and VD2 tracts with gentle slopes generally have no characteristics limiting for campgrounds, trails, and related park uses. Locally occurring coarse textures and high water tables may present problems for sewage disposal, but the coarse textured material provides gravel for construction purposes.

EACH TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

VL - VERMILION LAKES ECOSECTION

The Vermilion Lakes (VL) Ecosection encompasses wet fluvial and fluviolacustrine landforms on valley floors in the Montane Ecoregion. Gleysolic soils are characteristic but Organic soils and gleyed Regosol soils are common on some VL Ecosites. Vegetational features differentiate the four VL Ecosites (Table 119).

Wetness on VL results from high water tables and backwater flooding which causes imperfectly to very poorly drained soils. Fluvial material B on VL is low in coarse fragments. A low lime phase of Fluvial material B occurs in the Miette and Athabasca River valleys upstream from Jasper townsite. The interbedding of fluvial and fluviolacustrine materials on several VL Ecosites illustrates the dynamics of depositional environments over time. Soils in active or recently active sedimentation environments lack surface peat layers, whereas soils of geomorphically inactive localities have surface organic layers and include Mesisols on horizontal fens in ponded localities. VL1 and VL5 have the most abundant geomorphically active terrain. Slopes commonly range from 0 to 2% and are often channeled. VL1 is often ponded and small water bodies are common.

Table 119. General features of the VL Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
VL1	Level, horizontal fen	Fluviolacustrine material B (calcareous, fine-stratified), fen peat	Gleysol, Mesisol	Sedge fen (H11), wet shrubby meadow (S1), wet shrub thicket (S7)
VL3	Level	Fluvial material B (calcareous, coarse-stratified), Fluviolacustrine material B (calcareous, fine-stratified)	Gleysol	Wet white spruce forest (C4) > shrubby meadow (S1), wet shrub thicket (S7)
VL4	Level, apron, fan	Fluvial material B (calcareous, coarse-stratified), Fluviolacustrine material B (calcareous, fine-stratified)	Gleysol	Wet white spruce forest (C4)
VL5	Level, apron, fan	Fluvial material B (calcareous, coarse-stratified), Fluviolacustrine material B (calcareous, fine-stratified)	Gleysol > Gleyed Regosol	Wet shrub thicket (S7)

WILDLIFE

VL is very important to wildlife and is one of the most important in the two national parks. Critical winter range for elk and moose occurs here and many small mammal species reach high densities. Carnivores are attracted by these prey. Numerous bird species occur in the wetlands in high densities and many do not occur elsewhere in the parks. Uncommon raptors such as osprey and bald eagle nest in VL.

MANAGEMENT CONSIDERATIONS

Imperfect to very poor drainage, resulting from high water tables and backwater flooding, severely limits most park uses, unless expensive construction techniques are followed. On a number of VL tracts, particularly VL1, the flooding is accompanied by active sedimentation. Major construction activities (e.g. roads) on such tracts will change sedimentation and erosional patterns.

EACH TRACT SHOULD BE EVALUATED IN DETAIL FOR SPECIFIC PROPOSED USES.

WF - WILDFLOWER ECOSECOTION

The Wildflower (WF)Ecosection encompasses inclined landforms comprised of calcareous, medium textured colluvium in the Upper Subalpine portion of the Subalpine Ecoregion. Brunisolic and Regosolic soils dominate under avalanche complex v.t.s., Engelmann spruce-subalpine fir closed and open forest, mixed coniferous open forest, grassland, shrub thicket, and grassy tundra. Table 121 outlines five WF Ecosites separated primarily by vegetational differences.

Table 120. Wildlife features of the VL Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
VL1	high	moose elk	medium	weasel wolf coyote	low	beaver meadow vole	very high
VL3	high	moose deer elk	high	wolf coyote weasel cougar lynx	high	snowshoe hare columbian ground squirrel red squirrel	high
VL4	high	moose elk deer	high	wolf coyote cougar lynx	high	dusky shrew snowshoe hare red squirrel deer mouse red-backed vole western jumping mouse	very high
VL5	high	moose elk	high	coyote wolf lynx cougar	high	masked shrew dusky shrew snowshoe hare red squirrel meadow vole	very high

Table 121. General features of the WF Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
WF1	Blanket, veneer over inclined bedrock	Colluvium C (calcareous, medium textured)	Eutric Brunisol, Regosol	Engelmann spruce - subalpine fir closed and open forest (C15, C21, O10)
WF2	Blanket, veneer over inclined bedrock, apron	Colluvium C (calcareous, medium textured	Eutric Brunisol, Regosol, Humic Regosol	Avalanche Complex 2 > Engelmann spruce - subalpine fir closed and open forest (C15, O10)
WF3	Blanket, veneer over inclined bedrock > inclined bedrock	Colluvium C (calcareous, medium textured	Eutric Brunisol, Regosol, Humic Regosol	Mixed coniferous open forest (O4) > Engelmann spruce - subalpine fir open forest (O10)
WF4	Blanket, veneer inclined bedrock	Colluvium C (calcareous, medium textured)	Eutric Brunisol, Regosol	Engelmann spruce forest (C33)
WF7	Blanket, veneer over inclined bedrock	Colluvium B & C (noncalcareous, medium textured)	Eutric & Melanic Brunisol, Humic Regosol	Grassland (H14), shrub thicket (S10), grassy tundra (H4)

WF occurs on or below steep valley walls and is associated with calcareous bedrock. Slopes generally range from 45 to 100%. Soils are rapidly to moderately well drained. Snow avalanching characteristically affects more than 50% of WF2. Unvegetated portions may constitute up to 50% of some WF2, WF3, and WF7 tracts. WF4 and WF7 occur primarily in the Front Ranges on dry, southerly aspets. WF3 is the steepest of the five WF Ecosites and has the greatest abundance of lithic soils and rock outcrops. Avalanche Complex 2, for WF2, is a heterogeneous complex of v.t.s. that includes subalpine fir-willow (S2), willow-dwarf birch-shrubby cinquefoil (S10), juniper-willow (L2), hairy wild rye-wild strawberry-fireweed (H5), fleabane-valerian (H16), plus intergrades, with S2 being most abundant.

WILDLIFE

Table 122. Wildlife features of the WF Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
WF1	low		low	marten	medium		low
WF2	high	mountain goat bighorn sheep caribou	medium	wolverine	low	pika columbian ground squirrel golden-mantled ground squirrel	low
WF3	high	mountain goat bighorn sheep	low		medium	yellow pine chipmunk deer mouse	low
WF4	high	bighorn sheep mountain goat elk deer	medium	cougar wolf coyote	low	snowshoe hare	low
WF7	very high	bighorn sheep mountain goat elk	low	cougar	high	heather vole meadow vole long-tailed vole pika columbian ground squirrel	low

The importance of WF Ecosites to wildlife is variable. All but WF1 are highly important to ungulates. All Ecosites are of low importance to birds. To carnivores and small mammals the Ecosection is of low to moderate importance. Critical goat and sheep habitat occurs on WF2, WF3, WF4 and WF7.

MANAGEMENT CONSIDERATIONS

Steep and locally unstable (colluviating) slopes are limiting for many park uses. Snow avalanching, whether local (on WF1, WF3, WF4) or extensive (WF2), will affect winter uses. Shallow soils and bedrock outcrops on WF3 are factors to consider when planning certain uses (e.g. trails). Vegetation of WF3 recovers slowly from disturbances. WF4 is of limited areal extent. It is expected that vegetation on WF4 and WF7 recovers slowly from disturbances and that vegetation removal will significantly increase the chances of erosion, particularly colluviation. Droughty conditions on WF4 and WF7 will compound potential revegetation problems.

WH - WHITEHORN ECOSECTION

The Whitehorn (WH) Ecosection encompasses inclined landforms comprised of noncalcareous, medium textured colluvium in the Upper Subalpine portion of the Subalpine Ecoregion. Dystric Brunisols dominate under avalanche complex v.t.s., subalpine larch-subalpine fir forest, Engelmann spruce-subalpine fir closed and open forest, and mixed coniferous open forest. Table 123 outlines four WH Ecosites separated primarily by vegetational differences. Landscape position is shown in Fig. 31.

Table 123. General features of the WH Ecosites

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
WH1	Blanket, veneer over inclined bedrock	Colluvium B (non-calcareous, medium textured)	Dystric & Sombric Brunisol	Subalpine larch-subalpine fir forest (C23)
WH2	Blanket, veneer over inclined bedrock	Colluvium B (non-calcareous, medium textured)	Dystric Brunisol	Engelmann spruce-subalpine fir closed and open forest (C15, O10, C21)
WH3	Blanket, veneer over inclined bedrock, apron	Colluvium B (non-calcareous, medium textured)	Dystric & Sombric Brunisol > Humic Regosol	Avalanche Complex 2 > Engelmann spruce-subalpine fir closed and open forest (C15, O10)
WH5	Blanket, veneer over inclined bedrock > inclined bedrock	Colluvium B (non-calcareous, medium textured)	Dystric Brunisol > Regosol	Mixed coniferous forest (O4) > Engelmann spruce - subalpine fir open forest (O10)

WH occurs on or below steep valley walls and is associated with Miette Group or noncalcareous Mesozoic strata. Surface veneers of Eolian material B (altered, medium textured) occur sporadically. Slopes commonly range from 45 to 100%. Soils are rapidly to moderately well drained. Occurrences of subalpine larch-subalpine fir forest (C23) are restricted to southern Banff. Snow avalanching affects more than 50% of WH3. Unvegetated portions may constitute up to 50% of WH3 and WH5 tracts. WH5 is the steepest of the four WH Ecosites and has the greatest abundance of lithic soils and rock outcrops. Avalanche Complex 2, for WH3, is a heterogeneous complex of v.t.s. that includes subalpine fir-willow (S2), willow-dwarf birch-shrubby cinquefoil (S10), juniper-willow (L2), hairy wild rye-wild strawberry fireweed (H5), fleabane-valerian (H16), plus intergrades, with S2 being most abundant.

WILDLIFE

Overall, WH is of low importance to wildlife. However, avalanche slopes are highly important where they occur. Most areas are forested and receive deep snow which

Fig. 31 Landscape schematic of the Whitehorn (WH) Ecosite in relation to other Ecosites.

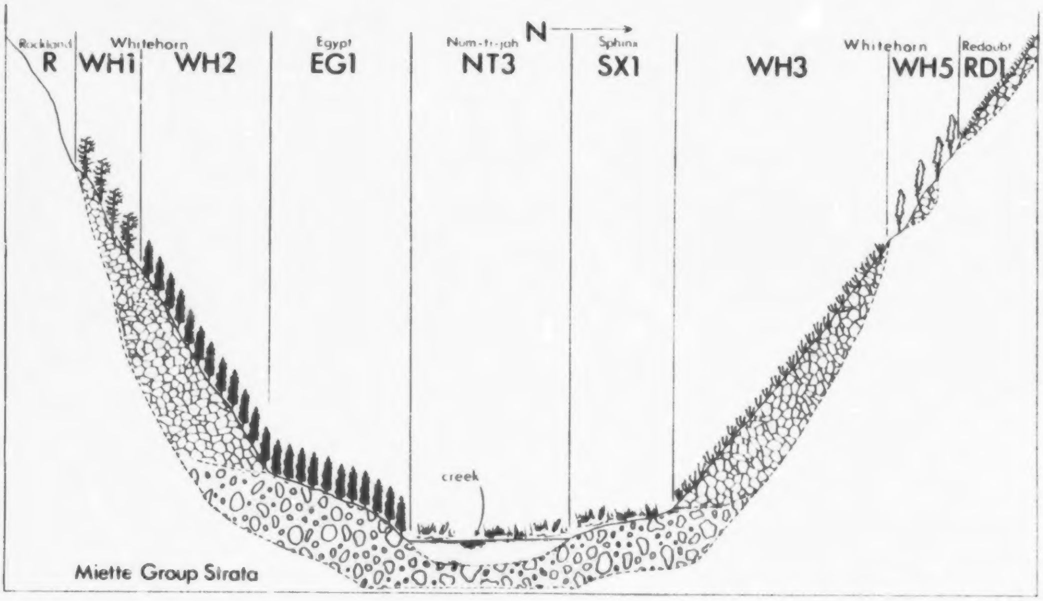

Rockland
R
Whitehorn
WH1
WH2
Egypt
EG1
Num-ti-jah
NT3
N
Sphinx
SX1
WH3
Whitehorn
WH5
Redoubt
RD1
creek
Miette Group Strata

Table 124. Wildlife features of the WH Ecosites

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
WH1	low		low	marten	high	heather vole	low
WH2	high	elk	low		medium	pika	medium
WH3	low		low	marten	low	pika hoary marmot	low
WH5	low		low		low	dusky shrew heather vole pika hoary marmot columbian ground squirrel	high

limits the usefulness to large mammnals. Some small mammals reach high densities on some of the Ecosites.

MANAGEMENT CONSIDERATIONS

WH1 and WH2 are of limited areal extent. Steep and locally unstable (colluviating) slopes are limiting factors to be considered for many park uses. Snow avalanching, whether local (on WH1, WH2, WH5) or extensive (WH3), affects winter uses. The shallow soils and bedrock outcrops of WH5 are other factors to consider when planning some uses (e.g. trails). Vegetation on WH5 is expected to recover slowly from disturbances.

WW - WARWICK ECOSECTION

The Warwick (WW) Ecosection encompasses hummocky and ridged morainal landforms comprised of calcareous, medium textured till in the Lower Subalpine portion of the Subalpine Ecoregion. Regosolic soils are dominant under herb mat vegetation. Table 125 summarizes the WW1 Ecosite. WW1 is an uncommon Ecosite restricted to the Main Ranges near the Continental Divide and is associated with recently retreating glaciers.

Table 125. General features of the WW1 Ecosite

Ecosite	Surface Expression	Genetic Material Unit	Soils	Vegetation
WW1	Hummocky, ridged	Till C (calcareous, medium textured)	Regosol, Humic Regosol	Herb mat (H8)

WW1 tracts occur on valley bottoms and lower slopes. Ice Contact Stratified Drift B (calcareous, variably textured) is an accessory genetic material. Complex slopes range from 5 to 45%. Soils are moderately well drained and display incorporation of decomposing herb mat (H8) vegetation into the surface mineral horizon. The yellow dryad-willow herb v.t. is a community that pioneers neoglacial landscapes.

WILDLIFE

WW1 is of low importance to wildlife.

MANAGEMENT CONSIDERATIONS

WW1 is of limited areal extent. The dominant Regosolic soils indicate recent glacial deposition. Vegetation can probably withstand moderate use but once destroyed is expected to recover slowly. Of particular concern are steep slopes and imperfectly to poorly drained depressional localities. Areas of WW1 are ideal for research purposes in such fields as glacial geology and geomorphology, paleoclimatic studies, soil genesis, vegetational succession, and naturally disturbed site rehabilitation.

ECOSITE MODIFIERS

Ecosite Modifiers are applied to individual tracts which are not part of an Ecosite concept. The Ecosite Modifiers are listed below.

Table 126. Wildlife features of the WW1 Ecosite

	Ungulates		Carnivores		Small Mammals		Birds
Ecosite	Ranking	Important Species	Ranking	Important Species	Ranking	Important Species	
WW1	low		medium	marten weasel	low	golden-mantled ground squirrel deer mouse	low

A - AVALANCHED

The Ecosite Modifier **Avalanched** (A) is used with a map symbol when 20 to 50% of a tract is modified by frequent snow avalanches, an occurrence common to many Subalpine Ecosites. The avalanching has little direct effect on soils but is largely responsible for the following v.t.s: subalpine fir-willow (S2), willow-dwarf birch-shrubby cinquefoil (S10), juniper-willow (L2), hairy wild rye-wild strawberry-fireweed (H5), fleabane-valerian (H16), and aspen/hairy wild rye-showy aster (C22).

MANAGEMENT CONSIDERATIONS

Ecosites affected by avalanching require modified management considerations, particularly for winter uses.

B - BURNED

The Ecosite Modifier **Burned** (B) is used when 50% or more of the vegetation of a tract is modified by fire and is not a recognized v.t.

MANAGEMENT CONSIDERATIONS

Burned areas may be conducive to accelerated rates of erosion, especially in the few years immediately following fire. They are often favorable for wildlife since fire usually results in forest being replaced by herbaceous or shrubby vegetation. Also, burned areas may serve as a research sites to determine the pathways and rates of vegetational succession.

F - FAILED

The Ecosite Modifier **Failed** (F) is of three types: old (inactive) rock glaciers; areas of slow mass movement, guided by a slip surface; and areas of deep, extensive and severe solifluction.

MANAGEMENT CONSIDERATIONS

Failed tracts with old rock glacier landforms should not receive changed management consideration because the rock glaciers are not expected to reactivate. Failed terrain that includes mass movement and severe solifluction will influence management considerations for park uses. Such tracts should be evaluated individually to determine the potential for further slope failure.

X - LITHIC

The Ecosite Modifier **Lithic** (X) is used when $\geq$ 50% of a tract is modified by shallow soils over bedrock, where the lithic contact is within the normal depth of the soil control section.

MANAGEMENT CONSIDERATIONS

Shallow soils and bedrock will change management considerations for Lithic Ecosites. Uses that require deep unconsolidated material (e.g. sewage disposal) will be precluded.

MISCELLANEOUS LANDSCAPES

CL - COLLUVIAL LANDSLIDE

The Miscellaneous Landscape **Colluvial Landslide** (CL) encompasses areas of sparsely vegetated landslide materials. Deposited by rapid gravity-induced movement, these deposits are a chaotic, generally loose, mixture of soil and rubble from a variety of genetic material sources. Surface expression is irregular, usually hummocky. Nonsoil dominates the landscape, with Regosolic soils occurring in local areas. CL is characterized by >80% unvegetated terrain. The remaining 20% is sparsely vegetated with saxicolous lichen (H12), spotted saxifrage-hairy wild rye (H20), and mountain avens-snow willow-moss campion (H1) v.t.s.

MANAGEMENT CONSIDERATIONS

Irregular topography, lack of soil and rubbly, blocky surfaces are the major factors to consider as limitations for most park uses.

CR - COLLUVIAL RUBBLE

The Miscellaneous Landscape **Colluvial Rubble** (CR) is derived from Colluvium A, B, or C, depending on the characteristics of the source bedrock. Colluvial Rubble is a subset of *colluvium* as defined by C.S.S.C. (1978b) which results from slow, gravity-induced movement caused by surface creep, solifluction, and sheet erosion. Nonsoil dominates, but Regosolic soils occur locally. CR tracts may be unvegetated, or sparsely vegetated with saxicolous lichen (H12) and mountain avens-snow willow-moss campion (H1) v.t.s.

MANAGEMENT CONSIDERATIONS

Land stability, as well as lack of soil and vegetation, are major factors limiting most recreational park uses. The colluviation process is slower than for CL and thus, may permit some uses, (e.g. trails) but at significant development and maintenance costs.

GL - GLACIER

The Miscellaneous Landscape **Glacier** (GL) includes glacier, firn, ice field, and glacierette. GL tracts occur in all Ecoregions except the Montane and occur mostly near the Continental Divide. GL is unvegetated and nonsoil. Occasionally GL is mapped as a complex with other Miscellaneous Landscapes.

MANAGEMENT CONSIDERATIONS

GL areas have scientific, ecological, and tourist interest. The implications for use are complex and require site specific studies by qualified personnel. The ecological concerns involve long term climatic and hydrologic influences of the environment.

M - RECENT MORAINE

The Miscellaneous Landscape **Recent Moraine** (M) encompasses areas of sparsely vegetated till, primarily Till C (calcareous, medium textured), and occurs in the Subalpine and Alpine Ecoregions near the Continental Divide. Ice retreat from these areas is so recent that Regosols and nonsoil are characteristic. The yellow dryad-willow herb (H8) v.t. usually pioneers these neoglacial landscapes. M is occasionally mapped as a complex with other Ecosites and Miscellaneous Landscapes.

MANAGEMENT CONSIDERATIONS

Areas of Recent Moraine have scientific, ecological, and tourist interest, particularly for geomorphological and pedological studies, as well as paleoecological studies of vegetational succession. The lack of soil and vegetation preclude many recreational park uses.

P - PITS

The Miscellaneous Landscape **Pits** (P) include borrow pits and fills, gravel pits, quarries, and refuse disposal sites. Because of small size, many disturbed sites cannot be mapped.

MANAGEMENT CONSIDERATIONS

Some Pits have been used as overflow campgrounds. These highly disturbed areas could often benefit from reclamation to blend them into the landscape more aesthetically and restore their biological productivity

R - ROCKLAND

The Miscellaneous Landscape **Rockland** (R) is comprised of consolidated bedrock of all lithologies and occurs in all Ecoregions. It is predominantly nonsoil and unvegetated, although some high elevation tracts are sparsely vegetated with saxicolous lichen (H12) and mountain avens-snow willow-moss campion (H1) v.t.s. Some tracts also have stunted trees growing in cracks and shallow pockets of soil. R is occasionally mapped as a complex with other Ecosites and Miscellaneous Landscapes.

MANAGEMENT CONSIDERATIONS

Lack of soil and vegetation preclude many recreational park uses. Steepness and safety problems are other limitations to their use. Aesthetic values are high, as is their use for geological studies.

RG - ROCK GLACIER

The Miscellaneous Landscape **Rock Glacier** (RG) includes predominantly unvegetated masses of poorly sorted, angular coarse fragments and fine earth material, cemented by interstitial ice a meter or more below the surface. It is a product of colluvial and glacial processes. RG is dominantly nonsoil, although Regosols do occur on older stable portions where vegetation has become established. RG is often mapped as a complex with Talus (T).

MANAGEMENT CONSIDERATIONS

RG areas are of scientific, ecological, and tourist interest. Steepness and lack of soil and vegetation are severely limiting factors for most recreational park uses.

SC - RECENT STREAM CHANNEL

The Miscellaneous Landscape **Recent Stream Channel** (SC) consists of level floodplains comprised primarily of calcareous, coarse textured glaciofluvial material in all Ecoregions. SC originates from glacial meltwater streams which are usually still rapidly aggrading. It is characterized by Regosolic and Gleysolic soils associated with sparsely or unvegetated sites. Pioneering v.t.s.,such as sedge-saxifrage (H3), herb mat (H8) and willow/horsetail (S7), occur in small, isolated patches. SC may also be mapped as a complex with other fluvial landscapes.

MANAGEMENT CONSIDERATIONS

Wetness, continuing landform building processes and, in some instances, flood hazard, are severe limitations to most park uses. SC tracts are ideal for studying vegetational succession, as well as for pedogenic studies.

T - TALUS

The Miscellaneous Landscape **Talus** (T) encompasses areas of a loose, angular, coarse fragment phase of either Colluvium A, B, or C, depending on the source lithology. Talus is a subset of *colluvium* as defined by C.S.S.C. (1978b) formed by gravitational falling, rolling, and sliding of individual fragments dislodged by physical weathering of steep, resistant rock walls. Talus is dominantly nonsoil and unvegetated, although a few tracts have Regosolic soils associated with sparse vegetation. It occurs in all Ecoregions and is occasionally mapped with other Miscellaneous Landscapes.

MANAGEMENT CONSIDERATIONS

Steepness, instability, and lack of soil and vegetation result in severe limitations for most recreational park uses.

W - WATER BODIES

The Miscellaneous Landscape **Water Bodies** (W) include named and unnamed lakes and ponds, both natural and artificial. The smallest Water Bodies shown are approximately 25 ha and are delineated at the high water level where seasonal fluctuations are evident. Water Bodies are mapped in all Ecoregions.

MANAGEMENT CONSIDERATIONS

Water bodies should be inventoried individually.

CHAPTER IV - RESOURCE USE INTERPRETATION [2]

W.D. Holland

INTRODUCTION

The soil, vegetation, and wildlife of the National Parks are natural resources which are studied to provide information useful in making decisions, with the expectation of a profitable return, social benefit, or reduction in the cost of management. The study and mapping of ecological (biophysical) resources serves this practical purpose by accumulating technical information on the natural resources and by providing this information for use in the planning and management of specific land areas or kinds of soil, vegetation, or wildlife.

This involves:

1. resource inventory – gathering basic information on the kinds, amounts, and distribution of soil, vegetation, and wildlife.
2. resource use interpretation – developing an interpretive classification
3. resource management plans – applying the interpretive classification to specific land areas and resources, and developing management plans.
4. resource management – operational application of the management plans

The primary purpose of the Banff-Jasper Ecological Land Classification has been resource inventory, and the maps and volumes of this report provide the basic resource information. This chapter deals with interpretive classification. The activities in points 3 and 4 above are beyond the scope of this report.

INTERPRETIVE CLASSIFICATION

Basic resource inventories contain a wealth of information which managers often find overwhelming in volume and detail. Therefore, it is necessary to simplify the information by grouping resource components into interpretive classes for specific purposes (Montgomery and Edminster 1966, Bauer 1973, Pettry and Coleman 1973, Zayach 1973, Westerveld and van den Hurk 1973). Each class contains resource components which have similar suitabilities or responses for a particular use or management. Thus, several Ecosites which have a similar suitability for trail use would be grouped into the same interpretive class. A range of classes, from high to low suitability, is developed for each specific use. Often the factors limiting suitability are noted as subclasses. For example, flooding may cause a low interpretive class rating for a particular Ecosite, while the low rating of another is due to excessive stoniness. Interpretive classifications are use specific and an Ecosite or land area which is rated low for one use may be rated high for others. Consequently, managers will need a series of interpretive classifications, all founded on the basic resource inventory, to make decisions involving various uses or management practices.

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[2] *Interpretation*, as used here, is the grouping of resource components on the basis of similar properties which affect their use. This is a different meaning of *interpretation* than often used by Parks Canada; this latter refers to the explanation of park features to visitors.

In making an interpretive classification, several principles should be observed:

1 Define clearly the purpose of each classification.

2 Classifications are generally based on the kinds and degree of limitation to a specific use. The ranges of the resource qualities which define the various classes should be defined as precisely as possible. Resource groupings are usually according to one resource quality.

3 Classifications generally contain few classes. An odd number of classes permits two extremes as well as a mean or average class, three to five being most common. More classes may be needed for intensive management, but a large number of classes becomes unwieldy and does little to help simplify the information.

4 The intensity of management for a particular classification must be stated because many limitations can be reduced by management. Thus, a factor, such as high tree density, which may be severely limiting in a backcountry campsite with a low intensity of management may present less severe limitations in a highly developed area where more in time management permits clearing of access roads, paths, and tent pads.

5 Interpretive classes are relative - good, fair, poor. Such groupings are dynamic and can be changed as situations change; for example, an altered management practice.

Examples of these principles applied to interpretive classifications based on soil limitations (Table 127) are in *Soils of Waterton Lakes National Park* (Coen and Holland 1976).

Table 127 Example interpretations of soil characteristics for selected park uses (Coen and Holland 1976)

Map Units	Degree and Nature of Limitations for Recreation Uses									Degree and Nature of Limitations for Engineering Uses										Suscept-ibility to water erosion
	Playgrounds			Camp Areas			Paths & Trails			Septic Tank Fields				Bldgs. with Basements			Local Roads			
	slight	moderate	severe	slight	moderate	severe	slight	moderate	severe	slight	moderate	severe	pollution hazard	slight	moderate	severe	slight	moderate	severe	
[illegible] 1 AC, AD		Stony	Slope CF[1] Moist		CF Stony	Moist		CF Stony		nil			Po		Stony		Stony			Low
1 1 DF, FF, 1 F		Stony	Slope CF Moist		Slope Stony CF	Moist		Slope Stony CF			Slope		Po		Stony Slope			Slope		Low
1 1 FC, G, 1 GH		Stony	Slope CF Moist		Stony CF	Slope Moist		Stony CF	Slope		Stony	Slope	Po		Stony	Slope			Slope	Moderate
15 AB		Flood Wet			Flood			Flood				W.T. Flood			Wet Str	W.T. Flood		Flood Str	Frost	Low
17 17 AC, AD			Moist CF		CF	Moist	nil			nil			Po	nil			nil			Low
21 AC			CF Moist		CF	Moist		CF		nil			Po	Stony			Stony			Moderate
21 F			CF Moist		CF	Moist Slope		Slope CF				Slope	Po			Slope			Slope	High
31 AB			Wet Flood			Wet Flood			Wet Flood		Perm	W.T. Flood			Sh-Sw Str Frost	Wet, W.T. Flood		Sh-Sw Frost	Wet Flood Str	Low

[1] Abbreviations as follows: CF = Coarse fragments, Stony = Surface stoniness, Moist = Useful moisture; Slope = % slope; Po = Pollution hazard; Flood = Flooding, Wet = Wetness (soil drainage); W.T. = Depth to seasonal water table, Str = Strength of soil as rated by Unified or AASHO; Frost = Susceptibility to frost heave, Perm = Permeability, Sh-Sw = Shrink-swell potential

Much of the interpretive information in the *Management Considerations* section of the Ecosection descriptions in this volume is based on soils. Procedures similar to those in Table 127 can be applied to vegetation and wildlife information as well. Much of the interpretive classification of soils is based on physical characteristics which have been well investigated by engineering research. However, comparatively little research has been done on the response of vegetation and wildlife to various uses and intensities of management. Thus, making realistic predictions of responses for all Ecosites is not possible within the framework of this study. Lacking such information, it is possible to make only limited interpretations based on the response of Ecosites which are currently receiving certain types and intensities of use. For example, if an area of a certain Ecosite is being used as a campsite and is deteriorating, one can assume that other areas of the Ecosite which receive the same type and intensity of use and management would also deteriorate. Such a limited interpretation would not apply to any other than this specific Ecosite.

Interpretive classifications may be presented either as tables (Coen and Holland 1976) or maps (Lindsay et al. 1973) in which areas with similar capability and limitation are designated with a common symbol. The single factor maps prepared by Kurt Seel of Parks Canada, Western Region, Calgary, are examples of interpretations that are effective for planning because the maps are easily understood.

Interpretive classifications also have limitations:

1. It is assumed that enough is known about the effects on a resource component of a certain use or management practice to accurately assess suitability. Such information is rarely as complete as desired. Thus, interpretive classifications are always subject to revision as new knowledge becomes available.
2. The boundaries on interpretive maps do not separate resource components or Ecosites *per se*, but are based on resource characteristics which significantly affect the specific use being examined.
3. An interpretive classification can be used only for the specific use for which it was developed. If information on another use is needed, a new grouping must be derived using the basic resource information.
4. The person developing an interpretive classification must be aware of the limitations of the basic resource inventory information. It is relatively easy to go beyond that range of validity of the data. Scale, in particular, must be carefully considered. Resource information in this report is presented at a scale of 1:50,000. Many land management decisions will require site specific investigation to determine if the broader scale interpretive class based on an Ecosite in this report is appropriate for a smaller specific area.

Four sources of information for an interpretive classification are:

1. Field data gathered during the inventory stage to describe classify, and quantify natural resources such as landforms, soils, vegetation, and wildlife.
2. Research plot studies testing the response of key soils, vegetation types or wildlife habitats to various management practices, e.g. irrigation, fertilizing, planting, cutting or burning.
3. Indirect evaluations estimating use suitability of unknown resources by comparing them with those for which information is available.
4. User experience utilized to determine the nature and degree of resource use suitability or limitation of tracts known to represent a particular Ecosite concept. Especially helpful experience may be that of wardens, naturalists or other personnel with extensive experience in National Parks.

Information about an Ecosite, derived from one or more of these four sources, can then be used to develop predictions about the response of other tracts mapped as that Ecosite to the use under consideration.

Generally, application of the predictions involves three steps:

1. All the natural resources are listed. This will usually be a listing of all the map symbols which represent unique tracts of land.
2. All data describing the natural resources are assembled. Items frequently affecting parks use often include, for example, slope, aspect, elevation, vegetation type, snow depth, and various aspects of wildlife use.
3. Using the principles identified above, the data are grouped into classes based on the information associated with each map symbol listed in 1 above. A five class rating might be:
    G = Good (slight limitations)
    F = Fair (moderate limitations)
    P = Poor (severe limitations)
    V = Very Poor (very severe limitations)

U = Unsuitable

The following demonstrates the interpretive classification process. In this example, the objective is to locate campground sites that can accomodate 2,000 people per night. The selection criteria for large campgrounds first must be established and then the land inventory data searched. Selection criteria might include:

1. Snow avalanche risk
2. Flooding hazard
3. Slope of the landform
4. Soil attributes which affect revegetaion, dustiness or ease of foot travel
5. V.t.s that affect ground cover, shade, screening, resistance to use or rapid recovery after use.
6. Wildlife attributes, such as use for winter range, calving, denning, nesting or migration
7. Size limits which affect use of the tract
8. Compatability with adjacent land uses.

The nature and degree of the limitation, as judged by the above selection criteria, determines to which of the five classes (Good to Unsuitable) a tract will be assigned. The guidelines established here should be carefully recorded so that as knowledge improves, the class limits can be reassessed.

Land classification maps and accompanying information can be stored by computers. Programs are being developed to allow planning teams to alter guidelines and then assess the effect of this alteration on the class limits of interpretive maps. This approach allows the development of a set of scenarios representing several proposed management or design alternatives.

There is no best way to interpret basic ecological inventory data. The foregoing outlines several principles and an example of one appraoch to analyzing inventory data. The method chosen however, must recognize the spatial limitations of the data and the reliability limits of the analytical data about Ecosites upon which responses are predicted.

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